THE

FOUNDRY TRADE JOURNAL

WITH WHICH IS INCORPORATED

THE IRON AND STEEL TRADES JOURNAL

VOL. 56 — Thursday, April 15, 1937 — No. 1078

PUBLISHED WEEKLY

Subscription Terms : 15s. per annum.
Foreign and Colonial : 17s. 6d. per annum.
All Subscriptions are payable in advance.

All Communications to be addressed to the Editor, the Advertisement Manager, or the Publisher of

THE FOUNDRY TRADE JOURNAL
49, WELLINGTON STREET, LONDON, W.C.2

Telegraphic Address : "Zacatecas, Rand, London."
Telephone : Temple Bar 3951 (5 lines).

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF

The Institute of British Foundrymen
The Institute of Vitreous Enamellers
The Welsh Engineers' and Founders' Association
and
The Foundry Trades' Equipment and Supplies Association

Institute of British Foundrymen

PRESIDENT : 1935-36
H. Winterton, "Moorlands," Milngavie, Dumbartonshire.

LIST OF SECRETARIES—

General Secretary : T. Makemson, Saint John Street Chambers, Deansgate, Manchester. London Office : 49, Wellington Street, London, W.C.2.
Birmingham, Coventry and West Midlands : A. A. Timmins, A.I.C., 21-23, St. Paul's Square, Birmingham.
East Midlands : B. Gale, "Parkdale," Boulton Lane, Alvaston, Derby.
Lancashire : J. E. Cooke, 1, Derbyshire Crescent, Stretford, Manchester.
London : R. Causebrooke, 133, Eton Road, Ilford, Essex.
Middlesbrough : D. R. Kinnell, Chas. P. Kinnell & Company, Limited, Vulcan Ironworks, Thornaby-on-Tees.
Newcastle-upon-Tyne : W. Scott, Sir W. G. Armstrong, Whitworth & Company (Ironfounders), Limited, Close Works, Gateshead-on-Tyne.
Scottish : J. Bell, 60, St. Enoch Square, Glasgow.
Sheffield : T. R. Walker, B.A., "The Priory," Oughtibridge, near Sheffield.
Wales and Monmouth : J. J. McClelland, 12, Clifton Place, Newport, Mon.
West Riding of Yorkshire : S. W. Wise, 110, Pullan Avenue, Ecclesshill, Bradford.

Bristol : A. Hares, Park Crescent, 648, Stapleton Road, Bristol.
Burnley : W. Haworth, 37, Westbourne Avenue, Burnley, Lancs.
East Anglian : J. L. Francis, 53, Cromer Road, Ipswich.
Falkirk : H. McNair, "Braewick," Larbert Road, Bonnybridge, Scotland.
Lincoln : E. R. Walter, M.Sc., The Technical College, Lincoln.
Preston : P. Leyland, 7, Ashley Terrace, Farington, Lancs.

The Institute of Vitreous Enamellers

President : Dr. J. W. Mellor, F.R.S., Sandon House, Regent Street, Stoke-on-Trent.
Chairman : W. H. Whittle, W. H. Whittle, Limited, Eccles, near Manchester.
Hon. Secretary : Miss E. Christine Elliot, 49, Wellington Street, Strand, London, W.C.2.

Foundry Trades' Equipment and Supplies Association

President : A. C. Turner, Russell House, Adelphi, London, W.C.2.
Secretary : K. W. Bridges, Grand Buildings, Trafalgar Square, London, W.C.2.

Welsh Engineers' and Founders' Association

President : W. E. Clement, Morfa Foundry, New Dock, Llanelly.
Secretary : J. D. D. Davis, 9, Royal Metal Exchange, Swansea.

BRITISH CAST IRON RESEARCH ASSOCIATION

The Registered Office and Laboratories of the B.C.I.R.A. are :—
21-23, ST. PAUL'S SQUARE, BIRMINGHAM
Telephone : Central 1885. *Telegrams : CIRA*
The B.C.I.R.A. Scottish Laboratories are :—
Foundry Technical Institute, Meek's Road, Falkirk
Telephone : 332

Contents

	PAGE
British and German Foundry Production Compared	305
Current Selling Prices	305
I.B.F. : Annual Conference at Derby	305
United States Output of Pig-Iron and Ferro-Alloys in 1936	307
East Midlands Branch Annual Meeting	307
Ingot-Mould Life	308
German Foundrymen's Technical Association	310
Gates and Risers for Steel Castings	311
Publications Received	312
Time Control in the Manufacture of Repetitive Castings	313
More Non-Ferrous Problems	316
Catalogue Received	317
The German Foundry Industry	317
Air-Flow Measurement	317
Silica Refractories	318
West Yorkshire Foundrymen Visit Doncaster Brassfoundry	318
Some Problems Involving the Accuracy of Machine-Moulded Castings	319
Spectroscopic Analysis	319
Japanese Pig-Iron Purchases	319
The Week's News in Brief	320
Forthcoming Events	320
Raw Material Markets	322

British and German Foundry Production Compared

Elsewhere in this issue we publish statistics relative to the German foundry industry, and last month we abstracted from the Fifth Census of Production figures germane to our own. Fortunately, the two sets of figures are comparable as they both refer to the year 1935. The number of foundries in Germany is given as 1,307, whereas in Great Britain the figure is much greater, probably double. The number of employees are not really comparable, as, judging by the inclusion of 400 odd crucible furnaces, those engaged in non-ferrous work are included in the German statistics, but excluded in the British figures. The respective numbers employed under these conditions were 131,264 and 107,456. Moreover, quite small concerns are also eliminated from the British returns. Probably the best figure capable of giving a true comparison is the consumption of pig-iron by the two industries, and here Germany used 1,596,679 metric tons and the United Kingdom 1,424,500 long tons, or just over 1 per cent. more. This is probably accounted for by Germany's larger steel industry, a fact exemplified by that country's manufacture of 89,229 tons of rolls and 271,215 tons of ingot moulds, as against 37,900 tons and 121,300 tons respectively in the United Kingdom. Of course, the former figure may include some extraneous matter. On the question of pipes, Germany is figured as having produced in 1935 349,846 tons, as against 396,100 tons—excluding rain-water goods—in the United Kingdom. Obviously, in the two countries the type of output varies, for whereas this country makes over 241,700 tons of ranges of various kinds, Germany makes 206,418 tons of radiators and boilers, and only 111,454 tons of ranges, whereas the British output of radiators may reach 120,000 tons a year. A very great discrepancy occurs in the returns of castings in the rough, so much so as to be unbelievable. The United Kingdom survey gives 340,000 tons for 1935 and the German 987,052 tons. We rather like Table I of the German statistics, and wish that our authorities would provide analogous data. The figures for malleable cast iron go to confirm Mr. Bagshawe's statement that the United Kingdom manufactures proportionately less of this commodity than do the other great industrial countries. Germany's output in 1935 was 88,300 tons as against 47,100 in the United Kingdom. A rather surprising result from a comparison of the set of statistics, and one which requires confirming, is that Germany's output of steel castings was 145,225 tons as against our 194,000 tons.

Considering that Germany has a 50 per cent. greater population than the United Kingdom, the British foundry industry has reason to be proud of the present statistical position.

Current Selling Prices

We referred in our last issue to non-ferrous metal prices, and the subject of iron and steel prices generally is arousing a good deal of public interest. A certain amount of criticism has been directed to the price of steel, and in some quarters steel makers have been accused of taking advantage of the present situation. Such criticism comes oddly from people who did not hesitate to take advantage of the depression and foreign competition in pre-tariff days to force iron and steel prices to a point which seemed likely to put the industry out of existence altogether in this country. This is the reason why the industry has not the capacity to exceed its present record output.

Prices are bound to rise because costs are rising and are likely to continue to rise. If, however, prices can be kept to limits dictated by these inevitable rises in raw material costs, then no harm will be done and there need be no fear of anticipating a slump. In so far as prices are raised beyond these limits and leading to quick profits, then there is likely to be a holding-off by consumers and consequently danger of a slump. The possibilities are well illustrated by the action of the London Passenger Transport Board in deciding to defer a vast programme of extensions which would already involve an increased cost of some five millions due to rising material prices. It is all to the good that public works of this kind should be undertaken when a recession of business is threatened and not while we are on the ascending curve of a boom.

Post-war experience has taught business men all too clearly that a few years of quick and easy profits are more than wiped out by a prolonged depression. Current requirements should be supplied at the lowest possible cost if the fluctuation curve is to become something like a straight line. As far as iron and steel products are concerned, there is reason to believe that prices are subject to strict control and that official auditors prevent undue price-raising. Once these products have been sold, however, there is apparently less control and there is reason to believe that official quarters wish the control in the iron and steel industry were extended to other industries to which tariff considerations do not apply. Speculation is an even greater danger than the maker who raises prices of his own products beyond the point justified.

Institute of British Foundrymen

ANNUAL CONFERENCE AT DERBY

The thirty-fourth annual conference of the Institute of British Foundrymen will be held at Derby from June 8 to 11 next. The conference is being arranged by the East Midlands Branch. The Papers which will be discussed cover many aspects of modern foundry practice, and the increasing importance of non-ferrous foundry work has been recognised by the arrangement of a special session of Papers on non-ferrous foundry subjects.

Derby, an ancient market town, has rapidly developed into an important industrial centre. This development has been very marked in recent years. Old-established firms have expanded, new industries have been established, and in no industry has development been so rapid as in the foundry trade. Derby is adjacent to several other progressive industrial towns, and the Derbyshire iron manufacturing district is close at hand. The Committee has been fortunate in receiving invitations to visit a number of industrial and educational establishments representative of the area, and foundrymen in almost every branch of the industry will be able to take part in works visits which will be of value to them.

Derby is not wholly industrial. It is set in the midst of delightful scenery and is only a few miles from the Peak District of Derbyshire, one of the most beautiful districts in the country. Members and ladies will have the opportunity of enjoying this delightful scenery on the closing day of the conference. The business of the conference will be interspersed with social activities, and a special programme of visits and excursions has been arranged for ladies.

Members who intend to participate can assist the organisers considerably by:—

(*a*) Returning their completed reply form as early as possible, and in no case later than Saturday, May 15. Late applications add considerably to the work of the Committee.

(*Note.*—Every effort will be made to deal with late applications, but as numbers are limited at many functions and visits, no guarantee can be given that late applicants will receive the tickets for which they apply.)

(*b*) Attending at all fixtures five minutes before the scheduled time. In order to carry out the programme satisfactorily, punctuality is essential, and members arriving at the starting place of buses after the times given in the programme may be left behind.

Programme

TUESDAY, JUNE 8.

6.0 p.m.—Annual general meeting in the Assembly Rooms (Ballroom), Market Place. (Open to all Members, Associate Members, and Associates.)

8.0 p.m. to 1.0 a.m.—Reception in the Bemrose School, Uttoxeter Road, by kind invitation of The Worshipful the Mayor (Councillor Mrs. Petty, J.P.) and Corporation of the County Borough of Derby. (All members and ladies.) (Evening dress.)

By courtesy of the Corporation, special buses will convey members to their hotels at midnight and again at 1.0 a.m.

WEDNESDAY, JUNE 9.

9.30 a.m.—Conference opens at the Guild Hall, Market Place. (All members and ladies.) Address of welcome by The Worshipful the Mayor of Derby (Councillor Mrs. Petty, J.P.); the President of Derby Chamber of Commerce (Mr. Cecil Murray), and Dr. A. Richardson, O.B.E., B.A., D.Sc., Principal of Derby Technical College.

Presentation of the Oliver Stubbs Medal.

Presentation of the E. J. Fox Medal.

Induction of new President and Vice-Presidents.

10.20 a.m.—Presidential Address by Mr. C. W. Bigg.

11.0 a.m.—Third "Edward Williams" Lecture: "Factors in the Casting of Metals," by Dr. C. H. Desch, D.Sc., Ph.D., F.R.S., Superintendent, Metallurgical Department, National Physical Laboratory. (This Lecture will not be printed in advance of the conference.)

12.0 noon.—Presentation and discussion of Paper No. 606: Recommendations of the Costing Sub-Committee of the Technical Committee.

12.45 p.m.—Conference adjourns.

1.0 p.m.—Luncheon, in the Assembly Rooms, Market Place.

Buses leave Corporation Street for the following works visits:—

1.45 p.m.—(2) Bamfords, Limited, Uttoxeter (agricultural engineers and ironfounders).

2.0 p.m.—(3) Ley's Malleable Castings Company, Limited (the largest malleable iron foundry in Europe).

2.0 p.m.—(4) Qualcast, Limited, Victory Road (repetition ironfounders; automobile castings; lawnmower manufacturers).

(*Note.*—Members may join one only of the above visits (2), (3) or (4), as each visit will occupy the whole afternoon. On return, buses will arrive at Corporation Street about 5.15 p.m.)

7.0 p.m.—Reception by the President and Mrs. Bigg, prior to annual banquet.

7.30 p.m.—Annual Banquet at the Bemrose School, Uttoxeter Road. Followed by dancing until 1.0 a.m. (Evening dress.)

By courtesy of the East Midlands Branch, special buses will convey members and ladies to their hotels at 12.0 p.m. and again at 1.0 a.m.

THURSDAY, JUNE 10.

9.30 a.m.—Conference resumes at the Technical College, Green Lane.

Session A.—Presentation of Papers Nos. 607, 608 and 609.

Session B.—Special Session of Papers on Non-Ferrous Subjects. Presentation of Papers Nos. 610, 611, 612, 613 and 614.

12.15 p.m.—Conference adjourns.

12.15 p.m.—Buses leave Technical College, Green Lane, for:—

(5) Works visit to Stanton Ironworks Company, Limited. (Luncheon by kind invitation of the company. Number limited to 120.) (On return, buses arrive at Corporation Street from 6.0 to 6.30 p.m.)

12.30 p.m.—Luncheon (for members not visiting Stanton Ironworks) in the Assembly Rooms, Market Place.

1.30 p.m.—Buses leave Corporation Street for the following works visits:—

(6) Herbert Morris, Limited, Loughborough (manufacturers of cranes and all types of lifting and conveying plant).

(7) Loughborough College, Loughborough (engineering training on actual production; extensive and well-equipped workshops, foundry and laboratories).

As each visit occupies the whole afternoon, members may take part in one only of (5), (6) or (7). (On return, buses arrive at Corporation Street, Derby, at 6.0 to 6.30 p.m.)

8.30 p.m.—Informal Social in the Assembly Rooms, Market Place, by invitation of the East Midlands Branch. Refreshment buffet. (Evening dress.)

FRIDAY, JUNE 11.

9.30 a.m.—Excursion for members and ladies.

Motor coaches leave Corporation Street for tour in Derbyshire, proceeding via Ashbourne, Waterhouses, Warslow, Longnor to Buxton. Luncheon at Buxton. Coaches then proceed via Millers Dale, Tideswell, Middleton Dale, Calver, Baslow to Matlock. Tea at Matlock by kind invitation of the President and Mrs. C. W. Bigg. Return via Belper, arriving at Derby about 7.0 p.m.

Ladies' Programme

TUESDAY, JUNE 8.

8.0 p.m.—Reception in the Bemrose School, Uttoxeter Road, by the Mayor and Corporation of Derby (see general programme).

WEDNESDAY, JUNE 9.

9.30 a.m.—Ladies are invited to attend the opening of the conference at the Guild Hall, Market Place.

10.30 a.m.—Buses leave Corporation Street for visit to: (1) Royal Crown Derby Porcelain Company, Limited.

1.0 p.m.—Luncheon in the Assembly Rooms (as for general programme).

2.30 p.m.—Buses leave Corporation Street for tour of Derby Parks. Tea at Darley Park. On return, buses arrive at Corporation Street about 5.15 p.m.

7.0 p.m.—Reception and banquet, Bemrose School (see general programme).

THURSDAY, JUNE 10.

Morning free.

12.30 p.m.—Luncheon (see general programme).

1.30 p.m.—Buses leave Corporation Street for the following visits: (8) Webb & Corbett, Limited, Tutbury Glass Works, Tutbury (party limited to 26 persons); (9) C. H. Elkes & Sons, Limited, Uttoxeter (biscuit manufacturers) (party limited to 32 persons); (10) Boots Pure Drug Company, Limited, Beeston, near Nottingham.

Each visit will occupy the whole afternoon, and ladies may therefore take part in one visit only. Buses arrive at Derby on return journey at 6.0 to 6.30 p.m.

8.30 p.m.—Informal Social in the Assembly Rooms (see general programme).

FRIDAY, JUNE 11.

Tour in Derbyshire (see general programme).

Programme of Papers

WEDNESDAY, JUNE 9.

No. 605.—Third "Edward Williams" Lecture: "Factors in the Casting of Metals," by C. H. Desch, D.Sc., Ph.D., F.R.S. (superintendent, Department of Metallurgy, National Physical Laboratory). (The Edward Williams Lecture is not published in advance of the conference.)

No. 606.—"Recommendations Concerning the Establishment of Costs in a Grey Iron Foundry," by the Costing Sub-Committee of the Technical Committee.

THURSDAY, JUNE 10.

SESSION A.—GENERAL.

No. 607.—"Wear Tests on Ferrous Alloys" (presented on behalf of the American Foundrymen's Association) by O. W. Ellis, Director of Metallurgical Research, Ontario Research Foundation, Toronto.

No. 608.—"Additional Data on the Manufacture of Ingot Moulds,"* by R. Ballantine (member) (Fulwood Foundry Company, Limited, Mossend, near Glasgow).

(*Continuation of "Developments in the Production of Ingot Mould Castings," by same author, given recently before the Lancashire Branch and Falkirk Section of the Institute.)

No. 609.—"Foundry and Laboratory Characteristics of Cupola Coke," by H. O'Neil, M.Met., D.Sc. (L.M.S. Railway Research Laboratories, Derby), and J. G. Pearce, M.Sc., F.Inst.P., M.I.E.E. (member) (director, British Cast Iron Research Association).

SESSION B.—SYMPOSIUM ON NON-FERROUS FOUNDRY SUBJECTS.

No. 610.—"The Elimination of Gaseous Impurities in Aluminium" (presented on behalf of the Association Technique de Fonderie, France),

by Professor Georges Chaudron, director of the Institute of Applied Chemistry, Lille.

No. 611.—"Re-melting Aluminium in the Foundry," by Chief Engineer H. Rohrig (Vereinigte Aluminium-Werke A.-G., Lautawerk (Lausitz)). (Presented on behalf of the Technischer Hauptausschuss für Giessereiwesen, Germany.)

No. 612. "Notes on the Structure and Characteristics of Aluminium Alloys," by H. C. Hall, M.Met., F.I.C. (Rolls-Royce, Limited, Derby).

No. 613.—"Trends in the Non-Ferrous Foundry," by L. B. Hunt, M.Sc., Ph.D. (member) (Editor "Metal Industry").

No. 614.—"The Use of Nickel in Non-Ferrous Alloy Castings," by J. O. Hitchcock, B.Sc. (member) (Mond Nickel Company, Limited).

Hotel Accommodation

There is always considerable demand upon hotel accommodation during the week in important industrial centres. In Derby the position is even more difficult, as there are few large hotels; there are, however, a number of smaller hotels where excellent accommodation may be obtained. *It is essential that hotel accommodation be reserved in advance.*

Hotels.	Charges per Night: Room and Breakfast. Single Room Rates from:	Double Room (2 persons) Rates from:	Distance from Market Place.
	s. d.	s. d.	
HOTELS NEAR CENTRE OF THE TOWN—			
Friary Hotel, Friar Gate	12 6	24 0	5 minutes.
White Horse Hotel, The Morledge	7 6	— —	1 minute.
Derwent Hotel, The Spot	6 6	13 0	3 minutes.
Oxford Hotel, Osmaston Road	6 0	11 0	5 minutes.
Stamford Hotel, Friar Gate	6 6	13 0	5 minutes.
HOTELS NEAR L.M.S. RAILWAY STATION—			
Midland Hotel, Midland Road	12 6	25 0	5 minutes (Bus).
York Hotel, Midland Road	7 6	15 0	5 minutes (Bus).
Portland Hotel, Midland Road	7 6	14 0	5 minutes (Bus).
Waverley Hotel, Midland Road	6 6	12 0	5 minutes (Bus).
Regent Hotel, London Road	6 0	11 0	5 minutes (Bus).
Carlton Hotel, London Road	5 6	10 0	5 minutes (Bus).
OTHER HOTELS—			
Melton Hotel, Ashbourne Road	7 6	13 0	7 minutes (Bus).
Grange Hotel, Ingleby Avenue, Normanton	8 6	17 0	10 minutes (Bus).
Broadway Hotel, Duffield Road	6 6	— —	10 minutes (Bus).
Park Hotel Chaddesden	6 6	13 0	10 minutes (Bus).
Moon Hotel, Spondon, Nr. Derby	7 6	15 6	4 miles.

When writing for accommodation please mention the conference.

The particulars listed in the above table have been supplied by the respective managements of the hotels named.

Accommodation for Cars.—There are numerous garages in various parts of Derby. A plan of public car parks in Derby will be given in the souvenir booklet.

General Notes

Registration.—Members and ladies attending the conference will receive by post prior to reaching Derby a registration card bearing Member's registration number. This card should be exchanged upon arrival at the conference office for a booklet of tickets for the functions and visits indicated by X on the Member's reply form.

Members who desire to have their tickets, Papers, etc., forwarded to them in advance of the conference, may obtain them by enclosing an additional 4d. per head, when sending their remittances to the secretary of the Institute. In this case, no registration card will be sent. In each case kindly check contents immediately.

Conference Office and Information Bureau.—The office will be open for the issue of tickets, booklets, copies of Papers, etc., as follows:—Tuesday, June 8, 2 p.m. to 6 p.m.; Wednesday, June 9, 9 a.m. to 12 noon, Assembly Rooms, Market Place; Thursday, June 10, 9 a.m. to 12 noon, Technical College, Green Lane.

Souvenir Booklet.—A souvenir booklet giving full details of the programme, notes of the district, works to be visited, etc., will be supplied to each member and lady attending the conference.

Badges.—In view of the issue of membership badges to all Members of the Institute, it has been decided not to issue a separate conference badge. A special badge will be presented to the ladies. Do not forget to bring the membership badge. The Institute's badge is engraved with the Member's name and year of election. Any Member who is not already in possession of a badge may obtain one at a charge of 2s., by applying to the secretary of the Institute before May 15. As the name has to be engraved on each badge, delivery in time for the conference cannot be guaranteed for badges ordered after this date.

Correspondence.—Members may have their correspondence forwarded to them during the conference period, addressed: c/o The Institute of British Foundrymen, Assembly Rooms, Market Place, Derby. Letters so addressed will be available at the conference office (Assembly Rooms or Technical College, Green Lane).

United States Output of Pig-Iron and Ferro-Alloys in 1936

Production of pig-iron and ferro-alloys in the United States in 1936, as officially reported in Statistical Bulletin No. 1, 1937, of the American Iron and Steel Institute, was 31,029,187 gross tons, as compared with 21,372,699 tons in 1935, 8,781,453 tons in 1932 and 42,613,983 tons in 1929. The number of blast furnaces in operation on December 31, 1936, was 176 out of a total of 247, as against 146 on June 30, 1936, and 124 on December 31, 1935.

By grades, the pig-iron output in 1936 (1935) included 20,476,921 (13,618,453) tons of basic iron, 5,876,762 (4,238,692) tons of Bessemer and low-phosphorus iron, 2,030,991 (1,645,252) tons of foundry iron, and 1,717,057 (1,205,744) tons of malleable iron.

The year's output of ferro-alloys totalled 812,640 (591,939) tons, and included 395,119 (289,279) tons of ferro-manganese and spiegeleisen, 360,490 (262,862) tons of ferro-silicon and 57,031 (39,798) tons of other ferro-alloys.

THE ANGLO-AMERICAN OIL COMPANY, LIMITED, have decided on a site one mile north-east of Hellingly, Sussex, for their first test bore in the search for oil in England.

East Midlands Branch Annual Meeting

The annual meeting of the East Midlands Branch of the Institute of British Foundrymen was held on March 20, at Loughborough College, Mr. H. Bunting (Branch-President) presided.

Presenting the annual report of the Branch, the honorary secretary, MR. B. GALE, said that during the year seven meetings had been held, in addition to the annual dinner, with an average attendance of 59. One works' visit was arranged to the International Combustion, Limited, of Derby, as a joint meeting of the East Midlands and Sheffield Branches; this was attended by 130 members.

The Branch was indebted to the following gentlemen who presented Papers during the year: Mr. S. L. Ireland, Mr. F. Dunleavy, Mr. S. A. Horton, Mr. A. E. Peace, and Mr. T. Spiers. In addition Mr. P. A. Russell and Mr. G. Shotten presented the Technical Committee's reports on Specifications for Two Leaded Gunmetals and Dimensional Tolerances for Castings with Particular Reference to Malleable Cast Iron. It was pleasing to note that this list included the names of four members of the East Midlands Branch and one member of the Lincoln Section.

Financially, the Branch had had a record year. The subscriptions at £220 were rather higher than the total year's subscriptions for the Branch membership. This was accounted for by the number of new members during the end of 1936, whose subscriptions were credited to 1937, and also to a large reduction in arrears.

Membership of the Branch over the year showed a net increase of 13, the following being the actual figures: New members, 23; resigned, 4; transferred, 4, and deceased, 2. The present membership of the East Midlands Branch was 130, in addition to which the Lincoln Section had a membership of 15. During the year this Section had been re-organised and the membership, whilst showing a decrease, was now an active membership and the Section was in a much better condition.

The election of officers resulted as follows:—*Branch-President*, Mr. W. T. Evans; *Senior Vice-President*, Mr. R. Spriggs; *Junior Vice-President*, Mr. R. Buckland; *honorary secretary*, Mr. B. Gale; *honorary branch auditors*, Mr. W. H. Smith and Mr. F. G. Butters; *delegates to General Council*, Mr. R. Spriggs and Mr. A. E. Peace; *representatives of the Technical Committee*, Mr. A. E. Peace and Mr. P. A. Russell.

Following the general business meeting, an interesting discussion took place on "members problems." Problems were submitted by Mr. F. Dunleavy, Mr. J. Lucas and Mr. H. J. Beck.

Institute of Metals

The Council of the Institute of Metals announces the temporary suspension of the entrance fee of one guinea hitherto payable by student members. Thus it now becomes possible for a qualified applicant, under 24 years of age, to join the student member class on payment of only one guinea—the amount of the annual subscription. The new scheme operates forthwith for a period of three years. Applicants whose names are submitted for approval at the next meeting of the Council—such names being received by the secretary, the Institute of Metals, 36, Victoria Street, London, S.W.1, not later than noon on April 29—may be elected at the beginning of July. As July marks the beginning of the Institute's new financial year, students then elected will enjoy a full year's membership in exchange for their guinea. They will receive exactly the same privileges as members, with the exception that they will have no voting powers. The publications that they will receive each year include three bound volumes of "Proceedings" and "Abstracts."

Ingot-Mould Life

By JOHN SHAW (Consulting Metallurgist)

So much has been written during recent years on the subject of ingot-mould life that the time seems opportune to assess the various conclusions put forward, in order to ascertain how far they contribute to an understanding of the factors governing the life of ingot moulds. In a number of cases the conclusions of various authors are contradictory, and in others no adequate proof is offered to substantiate their claims. It may be taken for granted that unless conditions are similar, both as regards steel practice, steel composition, mould size and shape, one cannot expect to obtain comparable life results. This will account for only some of the differences in results obtained by various investigators. For instance, Dr. Swinden[1] submitted a graph which showed that an increase in the thickness of the mould beyond a certain point decreased the life of the mould. At 3½ in. thick the moulds averaged 97 casts; at 4 in. thick the average dropped to 70 casts, while at 3 in. thick the figure was only 61 casts.

In September last year Reagan[2] claimed that wall thickness was one of the vital requirements for prolonging the life of the mould, and his ratio of mould weight divided by ingot weight was 1.96 to 1, against the author's figures of 1.2 (max.) to 1. Reagan's figures on the small moulds were:—Two groups with a mould weight of 5,300 lbs. averaged 154 and 163 casts; a group of moulds of 6,100 lbs. each gave 194 casts, while two other groups with a weight of 6,900 lbs. each averaged 224 and 254 heats respectively.

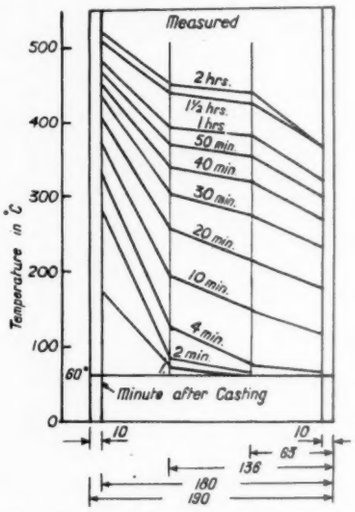


FIG. 1.—TIME-TEMPERATURE CURVES.

The thickness of the 21-in. twelve-sided mould was 5.93 in., compared with Dr. Swinden's 3½ in. on the 21-in. square mould. No comparisons as to the number of casts can be drawn from these two divergent types of moulds, but two facts do emerge. First, increasing the thickness of the mould does not in all cases lead to a decreased life. Secondly, major cracking is decreased by increasing the thickness of the mould. Dr. Swinden states: "That from their experience mould life is shortened principally by major cracking," while Reagan finds "The majority of cases of failure is due to heavy firecracking on the flats at a point 3 to 6 inches from the bottom radius of the mould."

During a recent visit to several Belgian foundries it was noted that the wall thickness of the ingot moulds was much in excess of the figure giving the best English results as quoted earlier. For instance, the 19½-in. square mould had walls 4⅞ in. thick. Major cracking was rare, and the moulds averaged 200 casts. In view of these results it would be interesting to learn if the 4-in. English moulds failed from major cracking or surface deterioration; also, if the composition of the metal had been altered to suit the slower cooling period of the thick mould, otherwise it gives a mould with larger graphite, grain size, lower physical properties and more liability to surface deterioration. It is known from some recent German work,[8] where cooling curves were taken from ingot moulds of various thickness, that the time for complete solidification for a mould 4.8 in. thick was 79 mins., while for a mould 3.54 in. thick the time was reduced to 47 mins., with a corresponding difference in time from 1,130 to 400 deg. C.

REFERENCES.

1 "Some Notes on Ingot Moulds." Institute of British Foundrymen Proceedings, 1934–5, p. 205. Swinden and Bolsover.
2 "Some Factors Affecting Life of Ingot Moulds." W. J. Reagan, "Metals Technology," September, 1936.
3 "Solidification Period of Ingot Moulds." K. Knehan and Berndt. "Stahl u. Eisen," August 27, 1936.
4 "Scientific Principals for Chilled Rolls." Emil Schutz. FOUNDRY TRADE JOURNAL, August 30, 1923, p. 176.
5 "Effect of Varying Cooling Conditions on Steel Ingots." F. Leitner. "Stahl u. Eisen," July 31, 1930, p. 1081.
6 "Corrugated Moulds." E. Gathmann. "Blast Furnace and Steel Plant," April, 1936.
7 "Why Ingot Moulds have Short Life." Hruska. "Iron Age," February 21, 1929, p. 539.
8 "Chilled Iron and Pseudo-Chilled Iron." Patsch. "Die Giesserei," March 13, 1931.
9 "Iron and Other Metals for Ingot Moulds." Hruska, "Iron Age," January 29, 1925, p. 341.
10 "Life of Ingot Moulds." Berglund and Johansson, "Jernkontoret's Annaler," 1933, p. 211.
11 "Developments in the Production of Ingot Mould Castings." FOUNDRY TRADE JOURNAL, January 7, 1937, p. 3, and January 14, p. 25.

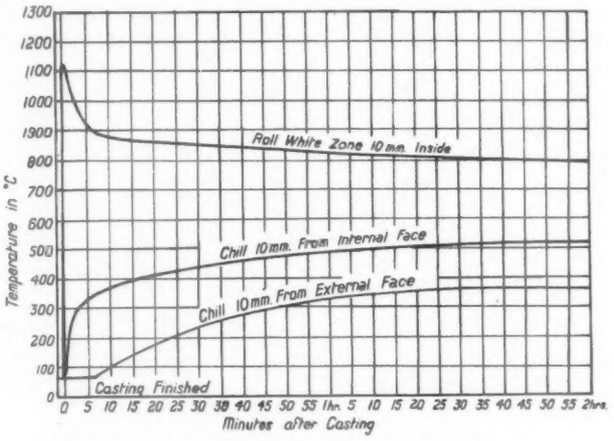


FIG. 2.—TIME-TEMPERATURE CURVES TAKEN ON CHILLS.

Structure and Composition

This raises the question of structure and chemical composition. It is accepted that the ideal material would be one having a close heat-resisting inner surface, combined with a background possessing good physical properties, especially resistance to stresses set up by the rapid alternations of temperature.

Is it possible to visualise what takes place in the mould during the casting of an ingot with steel at 1,600 deg. C.? There is little published work upon the subject of the changes in the mould, and it would help if the appropriate organisation would take a series of cooling curves at different points. Fortunately some work by Schutz,[4] who gives a picture of what occurs in a chill mould and the chilled roll, helps to clarify this question. Due allowance must be made, however, for the difference in effect between casting with iron at 1,200 deg. C. and steel at 1,600 deg. C. Taking a mould for a 28-in. sheet roll with a chill mould 7 7/16 in. thick, holes were drilled in this chill from the outside for the insertion of pyrometers at distances ⅜ in. from the inner face, and 5 in., 2 9/16 in., and ⅜ in. from the outer face. A further pyrometer was imbedded ⅜ in. in the roll itself. The cooling curves and the temperatures at various depths and times are shown on Figs. 1 and 2.

It was found that 5 mins. was necessary for transfer of the heat from the inner to the outer surface of the mould. The difference in temperature between the two surfaces increasing very quickly during the first 8 mins., with a maximum difference of 290 deg. C. after 10 mins., after which the difference slowly diminished. Very shortly after casting, the roll or ingot, owing to contraction and possibly some expansion of the mould, will not be in contact with the mould. Some experiments made in 1925 placed this time at 3 mins., and it can be noted in the flattening of the cooling curve. Under these conditions, a mould 8 in. thick will have no more chilling effect than one with walls 2½ in. thick. The thickness of the mould, therefore, is principally a question of strength and ability to resist the great stresses set up during casting. It is obviously unsafe immediately to recast into a mould that has just been stripped. If a mould is used again just after stripping, the internal face will attain a much higher temperature than at the first cast. The exterior surface will also have the same temperature as at the end of the first cast. There will thus be a much greater difference in temperature between the inner and outer surfaces, which increases the risk of fracture. In this experiment it was found that, at the end of 2 hrs., the moulds at ⅜ in. from the inside face had attained its maximum temperature (520 deg. C.), and had commenced to cool, although the casting inside was still 300 deg. C. higher, while the temperature on the outside of the mould only registered 370 deg. C.

In any attempt to draw a picture from these data, due allowance must be made for the difference between iron at 1,200 deg. C. and steel about 1,600 deg. C., as well as speed in pouring and difference in composition. McCance places the highest temperature at the face of the mould at 950 deg. C., so it can safely be presumed that 800 deg. C. at ⅜ in. from that face is correct. According to Leitner[5]: "Any increase in the thickness of the mould wall beyond 2¼ in. has

practically no influence on the chilled crystal zone." This is in agreement with what has gone before for rolls. If steel be poured into the mould, the inner surface will rise quickly to 550 deg. C. or more before the temperature on the outside of the mould has moved (dependent on the mould thickness). The linear expansion of cast iron at 550 deg. C. is approximately 0.087 in. per ft. The bursting pressure under these conditions is so severe that, according to Gathmann,[6] there is an expansion inwards by the compressed inner layers. To this, during the first few minutes, must be added the ferro-static pressure of the molten steel. Some 2 hrs. afterwards, dependent on ingot size, the inside of the mould reaches its highest temperature of, say, 800 deg. C. By this time the difference in temperature between the inside and outside of the mould is less, and thus the bursting pressure is less. The higher temperature, however, brings two other factors into play. According to some recent work by Parker, while the tensile strength of cast iron increases up to 300 deg. C., "grey cast iron above 650 deg. C. is so very weak mechanically that it would be positively plastic under a few tons stress (say 1 to 3 tons per sq. in.)." Thus the strength to resist the expansion pressure is considerably lowered, and depends largely on the cooler outer layers of the mould, and hence wall thickness. With temperatures up to 800 deg. C. permanent growth occurs, which increases with every cast until equilibrium is attained. As the outer layers, due to the lower temperatures, remain stationary, internal stresses are set up which may of themselves lead to ultimate failure. Reagan states: "Careful measurements of the interior of this type of mould have shown that as the life of the mould increases, the interior diameter gradually decreases by as much as $\frac{3}{4}$ in., while the outside diameter remains stationary." Hruska[7] has given some idea of the deterioration of the inner layers of the mould, with an increase of coarse crystallites to at least half way across the thickness. The mould selected for the experiment was 19½ in. sq. and 5 in. thick. The analysis before use was T.C, 3.54; Si, 1.43; Mn, 1.26; P, 0.104, and S, low. From it 118 ingots were cast of 0.21 carbon steel. Analyses, hardness and photo-micrographs were made from every ½ in. across the thickness of the mould, and the result shown in Fig. 3 and Table I were obtained.

From this investigation and others, Hruska suggests improvement should follow the following lines: "The tendency should be towards a decrease in the size of the graphite flakes, which points primarily to an addition of chromium to mould metal, or to some other change in chemical composition, or the thermal treatment of ingot moulds. Furthermore, the investigation points to the beneficial influence of an increase of the surface hardness of moulds."

Table I.—*Data from Ingot-Mould Experiment (Hruska).*

Location	1	2	3	4	5	6	7	8	9	10
Distance in ins. from inside wall..	0.25	0.75	1.25	1.75	2.25	2.75	3.25	3.75	4.25	4.75
Total carbon, per cent. ..	1.86	3.06	3.40	3.42	3.47	3.58	3.60	3.62	3.49	3.34
Graphitic carbon ,, ,, ..	1.84	2.88	3.04	3.19	3.10	3.16	3.35	3.41	3.36	3.16
Silicon, ,, ,, ..	0.61	1.36	1.41	1.43	1.40	1.40	1.38	1.36	1.38	1.18
Manganese ,, ,, ..	0.80	1.13	1.14	1.21	1.24	1.28	1.18	1.20	1.21	0.92
Phosphorus ,, ,, ..	—	—	0.118	—	—	—	—	—	—	—
Sulphur ,, ,, ..	0.124	0.112	0.110	0.108	0.074	0.064	0.069	0.067	—	0.097
Brinell hardness	99	96	92	85	81	79	76	76	77	84

Chemical Analyses

The analyses in Table II, arranged in terms of silicon, represent recent practice. It will be noted that the higher silicon irons are in use in this country, unless alloys are included. It is the usual practice to modify the mixture in accordance with the wall thickness, yet in this work, owing largely to the limit of 0.05 per cent. sulphur, moulds 4 in. and 10 in. thick are cast from the same metal. It is within this range of silicon (2.2 per cent.) and sulphur (0.037 per cent.)—allowance being made for loss and gain in the cupola—that one obtains a fair amount of pig-iron saturated with carbon, covering as it does the floor round the cupola with flying graphite, thrown out as the temperature of the metal in the ladle decreases. The inoculating effect of this graphite, according to recent practice, gives a large flakey graphite in the mould that is readily attacked. While the iron may be within the limits imposed for silicon, sulphur and phosphorus, the carbon content is not specified, and one may receive in a large consignment iron impregnated with graphite, to the "off" scattered fracture iron which melts "hard." If this statement be doubted, take wedge chill tests from each ladle for a week and note the difference in depth of chill. Some Continental firms have an advantage, as some furnaces stack each cast separately with their full analysis and history, and one is thus able to mix intelligently the various types. Other firms employ large mixers to obtain a regular product. Continental firms do not keep such a close control on the sulphur or phosphorus contents as English producers. This is no doubt due to the predominance of the basic open-hearth furnace. From personal inspection, sulphur reaching 0.08 or even 0.10 is common, associated with 0.10 per cent. phosphorus. Not one of the Austrian moulds referred to by Swinden would meet the usual British specification in this respect. From a number of American, French and Russian sources, the increase of manganese to well over 1.5 per cent. is advocated, and the published results would seem to justify this action. Moreover, the high manganese, by its reducing action on the sulphur, does enable one to use a lower silicon iron.

Chrome Additions

The addition of chromium has also been tried, and with its heat-resisting and refining qualities better results might be expected. Hruska, in four typical examples, with chromium ranging from 0.2 to 0.7 per cent., increased the life from 84 casts in the plain mould to 149 casts in the alloyed mould, or an advantage of 45 per cent. Dr. T. Swinden, in his first experiment, had an increased life of 30 per cent. on thirteen moulds, but further experiments did not confirm the results. In view of the fact that the first experiment was successful on a fairly large number of moulds, it would seem that some other factor influenced the result. It is useless to add chromium unless a proper balance with the other constituents is kept, and a proper temperature attained, otherwise the ferro-chrome is not properly disseminated, and these form nuclei which, according to Patsch,[8] act as centres for brittle carbide stars.

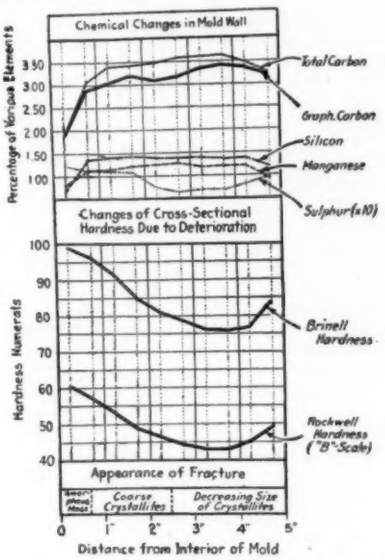


Fig. 3.—Hruska's Data on Changes in Mould Wall

Oxidation

Anyone who attended the Liège Foundry Conference and heard the discussion on the effect of oxides on the life of ingot moulds, by Le Thomas and Léonard, will be surprised at the use of active deoxidisers in Belgium and France, especially where 50 per cent. of the charge is scrapped moulds. Léonard used 15 per cent. Vantit iron, which not only contains a strong deoxidiser in the titanium, but a stabiliser against heat, and a grain size and graphite reducer in the vanadium present. The remainder of his charge consisted of 35 per cent. hematite and 50 per cent. old mould and scrap. From this he claimed an increased life of 50 per cent. on the stock moulds and 25 per cent. on slabs, whilst the number of casts per mould averaged about 200. Other deoxidisers containing titanium were in use in two other works.

Table II.—*Ingot Mould Compositions.*

	T.C. Per cent.	C.C. Per cent.	Si. Per cent.	Mn. Per cent.	S. Per cent.	P. Per cent.	Cr. Per cent.	Life.
English	3.5 to 3.75	0.3 to 0.6	1.9 to 2.3	0.6 to 1.0	0.03 to 0.05	0.03 to 0.05	—	97
Hruska	3.37	0.62	1.98	1.18	0.052	0.113	0.78	149
Blakiston ..	3.5	0.5	1.8	1.2	0.03	0.06	—	—
Ballantine ..	—	—	1.8	0.9	low	low	—	160
Williams	—	—	1.75	0.8 to 1.0	low	0.1	—	—
Grosclaude ..	3.25 to 3.5	—	1.5 to 1.8	1.75 to 2.25	0.05	0.1	—	175
Leonard	3.6	—	1.2 to 1.7	0.5	0.08	0.1	15 per cent. Vantit	215
Reagan	—	—	1.6 max.	1.5	0.05	0.1	—	180
Swedish	—	—	1.3 to 1.6	0.7 to 1.0	0.10	0.2	—	—
Hruska	3.5 to 3.75	—	1.0 to 1.5	0.75 to 1.2	0.06	0.15	—	118
Austrian	4.0	—	0.8 to 1.0	0.6 to 0.9	0.06	0.15 to 0.2	—	200

Internal Stresses in Moulds as Received from the Foundry

Certain statements have been made, attributing early failure to internal stresses existing in moulds as received from the foundry, but so far no adequate proof has been given. The answer on first thoughts seems so obvious that

it is apt to be accepted without question, but further consideration raises doubts. In thin castings with large cores, the chilling effect of the relatively cold mould causes rapid contraction, and serious internal stresses are set up if the core is not relieved. Does this occur in thick moulds, or is there time for readjustment in the long cooling time? Taking the 19½-in. mould, the cooling curve of which is given in the German Paper,[4] then the maximum contraction in this case would be $\frac{7}{16}$ in. The total solidifying time was 79 min. at 1,150 deg. C. Some 15 hrs. later, if uncovered, the mould would still be over 600 deg. C. It is difficult to imagine that the burnt sand, after 16 hrs. at a high temperature, would offer much resistance to that small contraction, or that during the long cooling period no readjustment to equalise any casting strains had not taken place. The accepted method for relieving casting stresses in cast iron is slowly to heat up the casting to temperatures between 450 and 550 deg. C., held at that temperature for one hour per inch of thickness, and then cool down slowly. This treatment will cause little decomposition of cementite or loss of physical properties. With the above specification in mind, even if the statement regarding internal stresses in the mould as received from the foundry be accepted, it is difficult to believe they are present after the first cast, with temperatures of 800 deg. C. inside and over 500 deg. C. on the outside of the mould, especially where the mould, after stripping off the ingot, is placed on grids so the air can circulate freely inside to help to equalise the temperature. It is here other stresses may be set up due to internal growth and the like.

Evidence Examined

In Swinden's Paper,[1] it was stated: "Many years ago it was found that in casting twelve-sided ingots of 19 in. diameter, the first ingot from a new mould was almost invariably cracked vertically in one or more corners. If the moulds were annealed at 800 deg. C. or an ingot cast of slag before use, the phenomenon was avoided. If the stresses in the mould had such an effect on the ingot, etc." It will be noted that the ingot cracked irrespective of whether the mould gave a good life or not, and it is therefore suggested that internal stresses in the mould had nothing to do with the cracked ingot. What really occurred was that there is always a certain amount of blacking impregnated into the face of a new mould, especially in the corners where the wire brush does not reach properly, and the clouds of smoke from a new mould during the casting of a first ingot are proof of this. The blacking on the two sides of the corners causes a hot spot, and consequently the rapidly-formed chilled tube of the ingot is thin at these points. When the main expansion of the inner core takes place, the chilled shell of the ingot is not strong enough at these points to resist it, and the vertical crack occurs. This phenomenon is well known to roll founders when attempting to use a badly fire-cracked chill filled up with blacking. This was also noted by Gathmann when designing his patent mould. In the discussion which followed Swinden's Paper, Blakiston stated: "When a mould cracked during its early life, the initial crack or plane of weakness was inherent in that mould when it left the foundry." From the context he attributes this to stresses set up due to the use of a corebar in the core, the elimination of the latter giving much better results. No proof is offered in support of these statements, and as 75 per cent. of the medium-sized moulds are made when using a corebar, further proof is necessary before accepting such a sweeping opinion.

Recently the author visited three Belgian foundries making ingot moulds. All used corebars, some round, others the shape of the core, but allowing 4½ in. of sand in each side. All the foundries removed the corebars and the outer boxes in from two to three hours after casting. In one case the red-hot moulds were stacked together with as much of the outer sand on their sides as held on, but care was taken to place them in a position free from all drafts. A second foundry stripped all the sand off the outside of the white-hot moulds, then placed them in a pit, covered them and luted up. A current of warm air was passed through the pit, and became heated by the hot moulds. It then passed into another chamber to dry the moulds for the next day's cast. A third shop stripped all the sand from the outside of the moulds and placed them in still air to cool. In each case the lives of these moulds averaged approximately 200 casts.

The author examined about fifty of the returned used moulds and in one case the interiors were better than in most English returns, but in the others much worse. No major cracking was in evidence except in some of the slabs where horizontal cracks due to enlargements of fissures at the hot spot was in evidence, such as shown in Fig. 9 of Dr. Swinden's Paper.[1]

In order to overcome the supposed internal stresses in moulds, the latter are subjected to a very slow cooling right through the critical range, and some of the larger moulds are left in the sand two or three weeks. In a casting with a carbon content of 3.74 per cent., silicon about 2 per cent., and a casting thickness from 4 in. upwards, is it to be wondered that under these slow cooling conditions the inside face of the mould is readily attacked by thermal corrosion or that the matrix possesses little or no real strength properties? Briefly, does the prolonged cooling time do much more harm than good, if the hot moulds are adequately protected from drafts and rain? It is apparent that long-life moulds can be made, whether the cores contain barrels or not. The bars are removed soon after casting, not only in the belief that doing so prevents stresses, but if they are not withdrawn during the "sweating" stage they have to be dug out, and thus double the fettling cost.

Annealing

Diverse opinions are held on the question of annealing. Hruska[6] states "A mould in daily use should be annealed at least once in two to four weeks; large moulds for 25 to 100 ton ingots after fifteen to twenty heats." On the other hand, Swedish writers say "Annealing does not lengthen the lives of moulds." Whichever verdict be accepted, one thing is certain, that it is not wise to heat the mould and hold it at 800 deg. C., as was mentioned earlier. This would result in the complete breakdown of those outer layers upon which primarily the resistance to major cracking depends. While it may be accepted that a low-temperature anneal will remove stresses set up due to differential cooling, it does not follow that it will relieve the stresses set up by the continuous growth of the inner layers. It is this factor, providing the firecracking on the inside does not cause rejection, that leads eventually to the major cracking on the outside mentioned by Dr. Swinden. From some recent temperature figures obtained on a large mould, it seems probable that a self-annealing takes place after every cast. Some twelve hours after casting the inner temperature of the mould was 480 deg. C., while the outside registered 380 deg. C. After 24 hrs. the difference was only 55 deg. C., although at an early period the difference between the inner and outer sides of the mould was 550 deg. C. The manufacture of ingot moulds has been fully dealt with by Ballantine[11] and others.

Enough has been said to indicate the methods proposed by various authorities as to how the lives of ingot moulds may be increased, but in every case, whether by a closer control of the pig-iron, additions of alloys or deoxidisers, it leads to increased expense in manufacture, and the subject must be governed by the economic consideration "Will the extra life pay for the extra expense?"

German Foundrymen's Technical Association

The annual meeting of the Verein Deutscher Giessereifachleute is to be held at the Berlin Zoological Gardens on May 8 and 9, and we feel sure that any British foundryman who care to take part will be welcomed. The meeting for technical purposes is to be divided into three groups, and the following Papers are to be submitted to the various sections:—

Group A.—Non-Ferrous Foundrywork.

(1) "Design of Magnesium Castings in Consonance with the Characteristics of the Metal," by Dipl.-Ing. P. Spitaler, of Bitterfeld.

(2) "Iron Chills (or Dies) for Aluminium Alloys," by Dr.-Ing. A. Väth, of Altona.

(3) "Foundry Fluxes, their Use and Effect with Aluminium Castings," by Dr.-Ing. R. Irmann, of Neuhausen—Switzerland.

(4) "Foundry Properties of Non-ferrous Casting Alloys," by Mr. F. Höhne, of Leipzig.

(5) "Process Problems in the Making of Die Castings," by Dr. W. Müller, of Berlin.

(6) "The Manufacture of Metal Pattern Plates and Core Boxes for Light Alloys," by Mr. H. Reininger, of Leipzig.

Group B.—Steel and Malleable.

(7) "Research and Supervision in Steel and Malleable Iron Foundries," by Dr.-Ing. K. Roesch, of Remscheid.

(8) "Transverse Tests from Malleable and Steel Castings," by Dr. F. Roll, of Leipzig.

(9) "Wärmmessugen bei der Anfertigung von Metallscheiffen" ["Heat Measurements for the Finishing of Metal Surfaces"?], by Professor G. Kritzler, of Brunswick.

(10) "Metal Conservation through the Use of the Duplex Process," by Dr.-Ing. E. Knipp, of Egge.

Group C.—Grey Iron.

(11) "Researches into Moulding-Sand Preparation," by Professor H. Uhlitzsch, of Freiburg.

(12) "The Graphitic Structure of Cast Iron and its Relation to the Inoculants in the Melt," by Professor E. Diepschlag, of Breslau.

(13) "Grey Iron Crankshafts," by Dr.-Ing. Th. Klingenstein, of Zuffenhausen.

(14) "Present Position of Superheating Cast Iron," by Professor E. Piwowarsky, of Aix-la-Chapelle.

(15) "Experiments for the Better Utilisation of Available High-Duty Cast Iron in Constructional Engineering," by Professor A. Thum, of Darmstadt.

(16) "Recent Developments in the Melting of Steel and Cast Iron," by Dr.-Ing. P. Bardenheuer.

In addition, two Papers are to be given correlating the politico-economic programme with the foundry industry.

Foundrymen desiring to participate in this meeting should write to the Geschäftsstelle des Vereins deutscher Giessereifachleute, Berlin, N.W.7, Friedrichstrasse 100, Germany.

International Scrap Negotiations

A further meeting of representatives of the principal European scrap-importing countries to discuss further details of the proposed international agreement for communal scrap purchases and distribution was held last Thursday, April 8, at Venice. It is now stated that the distribution of purchased scrap is to be on the basis of effective imports of the countries concerned in the three-year period, 1934-1936. According to some reports, agreement has already been reached between the representatives of Great Britain, Germany, Italy, Poland and Czecho-Slovakia, and joint purchases of scrap have already been made on the basis of tentative arrangements.

Gates and Risers for Steel Castings*

By A. D. KIRBY

Although innumerable Papers have been presented dealing with the method of gating and feeding steel castings, widely different opinions are still held as to the correct methods to be employed. Perhaps this can be understood when one bears in mind that a number of other factors have to be considered besides the allocation and type of gates.

One can scarcely expect for instance to get the same results from a casting made with steel from a modern electric furnace, as from the same casting made by the open-hearth process if the method of gating be the same in both cases, and is especially favourable to the electric furnace process. The author has in mind, when making this statement, certain types of intricate and thin sectioned castings which can be made quite successfully with electric furnace steel by using gates so small that it is doubtful if steel from most open-hearth furnaces would run through the same sized gates. The fluidity or life of steel is a vital factor to be considered when the question of gating is under review. Therefore gates of a certain size and shape are not suitable for every steel foundry.

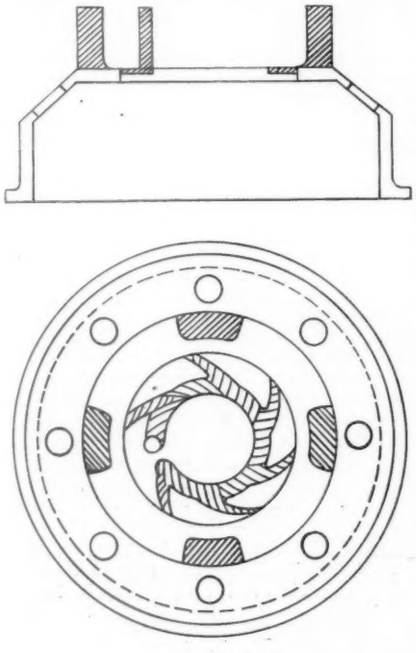


FIG 1

It is intended, however, to put forward in this Paper a certain principle of gating, which the author has proved to be greatly superior to the generally adopted method of gating at the lowest part of the casting, or in some cases at the joint of the mould. The method of running castings from the highest point of the mould was, it is thought, first introduced in a general sense by M. Ronceray, a very eminent gentleman in the French founding industry, and it is a matter for surprise that the method has not been more widely adopted in this country. Whilst agreeing that it is not possible to employ this method in every instance, it is thought that whenever it is possible to run a casting from the top, far better results are obtained, particularly when a number of small gates are used, instead of one common gate.

Even when using the Tropenas method of steelmaking (and it is believed the majority of foundrymen will agree that the fluidity of Tropenas steel is not always what one would desire), it is rather surprising what small gates can safely be employed. Several hundreds of castings, weighing 1¼ cwts., using approximately 1½ cwts. of steel to cast them, have been made using four in-gates positioned at the top of the casting, each runner being ⅜ in. by ¼ in. These castings are roughly 30 in. in length and 10 in. at the largest diameter. The section varies from ½ in. to 1¼ in., and, including the depth of the riser, the steel has to drop a distance of nearly 3 ft. The feeder is 4 ft. in length, this amount of head being quite sufficient to ensure soundness. The sectioned castings [exhibited] is a striking example of the efficacy of running a casting from the top, using a number of small gates.

When it is considered that the only chilling effect is obtained from the 3 in. dia. base chill, which is 2 in. deep, and the internal chill, which is 1 in. in dia., it will be agreed that the absolute freedom from sponginess or segregation at the bottom portion of the casting is really remarkable. This is due to the method of running the casting. The steel rises in the mould so slowly that it solidifies almost immediately, and it would be safe to predict that if this casting was run from the bottom, a certain porosity or sponginess would inevitably result. It may be thought that there is an element of risk in allowing steel to drop through such a narrow space, being in constant contact with both mould and core, and that there is a danger of scabbing or erosion. This is not the case providing both mould and core have been suitably prepared to obviate such a happening. The test figures for this casting are given in Table I.

Table I.—*Tensile Properties of Pencil Gated Casting.*

Test bar No.	M.S. Tons per sq. in.	E. per cent. on 1.4 ins.
1	37.6	23.9
2	36.5	27.0
3	36.5	21.1

Mould and Core Preparation

It must not be forgotten that the preparation of moulds and cores is definitely connected with the question of gating. When a number of gates are employed, obviously the chances of erosion are minimised considerably, but it is equally obvious that a certain erosion will take place when steel is allowed to fall a distance of 3 ft. in constant contact with both mould and core, unless steps have been taken to safeguard against this, by reinforcing the mould and core faces.

Although certain steel foundrymen still cling to the old idea of making a hard mould face by applying a paint, usually silica flour bonded with dextrine or similar material, personal experience has shown that spraying the face with oil gives far better results. There is a definite danger of spalling when using silica flour, which is non-existent in an oil sprayed mould.

Mr. R. F. Hudson recently dealt with the futility of preparing a permeable mould, and then destroying the permeability by the application of a paint. The author is in entire agreement with his point of view, and fully believes that the future success of mould facings must be in the application of an oil sprayed on the mould, which, whilst still giving an intense surface hardness, does not impair the permeability to any extent, and only along these lines are the methods of gating described to be recommended.

Increasing Gate Sizes Condemned

Several Papers have appeared in the American technical Press, dealing with the question of gates and risers, and the author of one of these articles put forward certain illustrations, to explain why he advocated a particular type of in-gate. The type of in-gate he recommended was one which gradually increased in size from the down-gate until it connected with the casting. To illustrate the benefits to be derived from this type of in-gate, readers were asked to imagine a stream of water passing through a hose pipe. If an enlarged connection was attached to the hose pipe, the water would naturally flow out very steadily, whereas if a reducing nozzle was attached, the water would naturally leave the hose pipe at a much greater velocity.

Instead of retarding the speed of entry into the mould, by necking the in-gate near the down-gate, it is suggested that the best method of preventing erosion of the moulds (which, of course, is what the American writer was desirous of avoiding) is to employ several in-gates, so dimensioned that they all functioned simultaneously, and all decreased in area towards the casting.

This theory is entirely contrary to the American practice described, but it cannot be agreed that a heat of steel poured from a ladle should be likened to water flowing from a hose pipe.

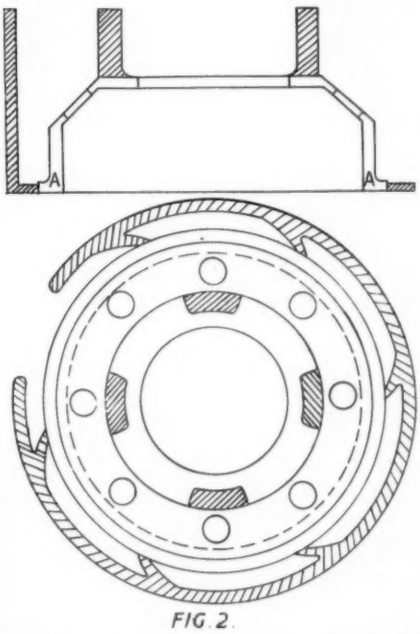


FIG 2

Although one sometimes hears the remark when an exceptionally good heat of steel is forthcoming that it "runs like water," it is well known that it is more apparent than real. Even if steel leaves the ladle like water, it soon loses its life when it comes in contact with the mould face and the atmosphere. This is readily confirmed if one looks down a riser, and observes the sudden cessation of flow at different points of the mould. Reference is made to moulds gated at the bottom or towards the bottom of the mould.

The suggestion that by gradually reducing the area of the in-gate, velocity is increased, is certainly not the case when employing a number of in-gates, bearing in mind that the total area of the in-gates is relative to the area of the down-gate. The frictional resistance set up by a number of small in-gates must impede the progress of the steel. One important feature in favour of a number of in-gates is that local heating of the mould is reduced proportionately to the number of gates employed. A convincing proof of this was afforded during the experimental stages of the casting exhibited. No trouble was experienced when casting this job with four small in-gates, but in the initial stages

* A Paper read before the Scottish Branch of the Institute of British Foundrymen, Mr. Frank Hudson presiding.

a few of these castings were run with two somewhat larger gates. Unsightly tears, extending in some instances to 8 or 9 in. in length, were revealed, directly in a line with the paths of the steel. This was undoubtedly due to local heating of the mould and core, and because the final delivery of hot steel in those paths caused an unequal solidification and contraction.

Even if it is not always possible or practicable to run a casting from the top, it is still advisable to use a number of small in-gates in preference to a single in-gate. Certain jobs obviously are not adversely affected by using only one in-gate, but quite a number of jobs which are cast with only one in-gate could be improved and small faults eradicated by the judicious application of a number of in-gates.

Blank Ring Castings

To quote one example, how often has one found a more or less pronounced ovality in a blank ring casting when using only one in-gate? Surely commonsense and experience should indicate that something of the sort would occur. Uneven contraction must be set up when using only one in-gate, which in addition to locally heating the mould, delivers the final hottest steel at the same part of the mould. If the conditions are equalised as much as possible the trouble will probably disappear.

When using a number of in-gates, the total in-gate area must be arranged in relation to the area of the down-gate. Unless the in-gates function simultaneously the object of their use is defeated. One of the benefits to be derived from this method of gating is that the amount of feeder head can be appreciably lessened. If any doubt exist as to the practicability of using such small gates as were previously mentioned, consideration of the amount of steel that can be lost through, say, $\frac{1}{16}$ to $\frac{1}{8}$ in. of fin on the joint of a mould, should be convincing proof that in-gates of the size mentioned running from the top are quite sufficient to accomplish their purpose.

A Brake Drum Casting

Fig. 1, which illustrates a brake drum for a motor lorry, is a typical example where top running can be used advantageously. Considerable trouble was experienced with this type of casting when gated at the bottom as is shown in Fig. 2. When using the bottom gates sponginess was often disclosed after machining in the region A, but this can be expected when it is realised that when the mould is completely filled, the hottest steel is situated at the lowest part of the mould, consequently being the last part to solidify.

From Fig. 1 it will be seen that a continuous supply of hot steel is being delivered when run from the top and no chilling action or back pressure is possible under these conditions. It is safe to say that sponginess entirely disappeared after adopting this method of gating. It should be noted that all the in-gates are arranged to give a spinning effect to the steel. Whether the runners are positioned internally as shown, or externally, this type of runner is strongly recommended. When contraction takes place there is less likelihood of distortion, or tearing, when using gates of this description, than when using in-gates positioned at right angles to the cross runner.

Whilst recognising that faults in design are responsible for some of the defects in steel castings, faulty positioning of the runners is often a contributory cause of scrapped castings which are sometimes wrongly attributed to design. The tension set up by in-gates positioned at right angles to the cross runner is out of all proportion when compared to runners positioned as shown in Figs. 1 and 2.

A Rope Pulley

This view of a pit rope pulley (Fig. 3) is shown to emphasise the importance of avoiding tension. The arms are diverted at the extremities, joining the rim in a similar manner to the recommended in-gates, except that whereas the in-gates all take the same course, the arms of the pulley branch to both left and right. This is, of course, just to produce a symmetrical effect, the object in both cases being identical, namely, maximum freedom during the contraction period. When these pulleys were cast with straight arms, considerable trouble was experienced with both tears and distortion. Permission was granted to change to the present design and these troubles have entirely disappeared. Even

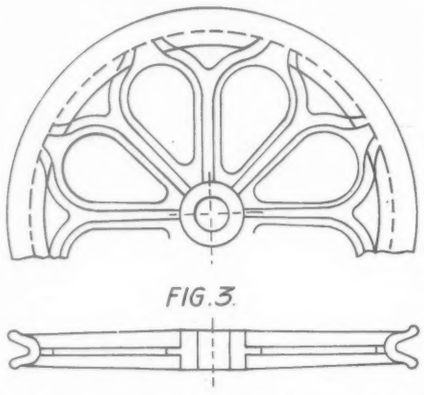


FIG. 3.

if only one runner is being employed, it is still good practice to deviate from a straight course, and give every assistance to the casting during contraction.

Two Practices Compared

Fig. 4 illustrates why the area of the in-gates should be reduced as they proceed towards the casting. No. 1 represents the type of in-gate suggested by the American foundryman referred to, and No. 2 the type recommended by the author of this Paper. Only one in-gate is shown, but the following remarks still apply when a number of in-gates are used. In No. 1 the steel commences to solidify first at A. Although there is a supply of molten steel in the down-gate B to compensate for liquid shrinkage at A, this supply is of no value as soon as A has completely solidified. When this is accomplished progressive shrinkage and solidification towards point C portends that trouble is likely to occur somewhere beyond the region of C. Being debarred from obtaining the necessary supply of

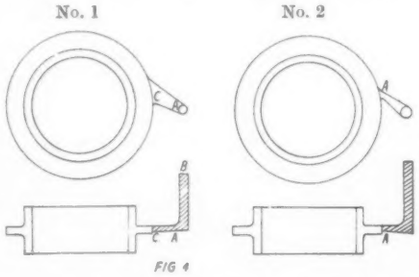


FIG 4

molten steel from the down-gate owing to the initial freezing at A, the remainder of the in-gate commences to draw a supply of molten steel from the adjacent casting. If, as is often the case, the section of the casting is such that it is impossible to overcome this drawing away of steel into the freezing in-gate, the result is a drawn hole, or sponginess. In No. 2 type of in-gate, freezing takes place firstly at A, but, having a progressively larger supply of molten steel towards the down-gate, that supply is called upon to serve its purpose.

Heads on Risers

Although perhaps not so important as the gates, the types of heads or risers required for steel castings demand a certain amount of forethought. Generally speaking, circular heads are preferable to rectangular heads. Area for area the first named is far more efficient than the latter, and the outside surface area being less, it is natural that the steel will remain molten longer in a round head than in any type of rectangular head. The object of a feeder head being to supply steel to compensate for liquid shrinkage in the casting, it follows that heads should be just large enough to achieve their object, but some foundrymen apply feeder heads in excess of requirements.

Apart from the economic point of view, this tendency to feed a casting excessively is to be deplored. The prolonged local heating set up when such conditions appertain is often the cause of tears appearing on the casting. This fault is nearly as common with some moulders as the equally bad habit of placing feeder heads too near the box bars. Whilst the steel foundryman has to exercise his ingenuity to overcome the problems encountered due to design, some of his troubles are self sought. Variations in section at parts of the casting where it is impracticable to apply feeder heads, can be controlled by the judicious application of chills, external or internal, or by the use of brackets, but the beneficial effects of such expedients are in many cases nullified by applying heads either wrongly positioned or much too large for their purpose.

The desirability of allowing the casting to contract at all points as nearly as possible at the same time, can only be accomplished by paying careful attention to the size of the feeder heads. Certain castings require risers which are purely and simply risers, and do not in any way feed the casting. Thin sectioned castings which do not require feeding, nevertheless require assistance to promote a sharp run casting, relieve strain and overcome potential blow-holes. Despite a permeable mould, the last named trouble is sometimes encountered in certain thin sectioned castings unless special precautions are taken. Applying whistlers at parts of the mould where the steel rises rapidly, and where there is a distinct chance of trapping air, is certainly helpful, but it is sometimes necessary to supplement this by using small flow-off risers.

In conclusion, the author regrets that he has devoted more of this Paper to gating than he has to risers, but he believes gating to be the far more important factor of the two.

Publication Received

Rightward Method of Oxy-Acetylene Welding. Published by the British Oxygen Company, Limited, Thames House, Millbank, London, S.W.1.

A little while ago our neighbours were concerned because the local council decided to replace the street electric lighting system by town's gas. Yet the roads have been better lit and the lamps are cleaned more often. We have given this short preamble because, in the field of welding, some engineers without entering into detail imagine that because electric welding is of more recent origin it must necessarily be superior to oxy-acetylene. As is correctly pointed out in the foreword to this pamphlet, "for any particular job there is one method which is pre-eminently suited for that job, but it is the object of this booklet to show that oxy-acetylene welding has a very much larger field than is usually realised." The publishers have unquestionably achieved their object, for they have shown how the oxy-acetylene blow-pipe, when intelligently used, can make a highly satisfactory job, economically and technically superior, by the utilisation of the rightward method of operation. We are particularly impressed by the coloured plates forming the centre of the booklet, and by the dispersal of heat to be associated with the two methods (pages 10 and 11). This very interesting pamphlet is available to our readers on request.

Time Control in the Manufacture of Repetitive Castings

By BERNARD BROWN, B.Sc.

[*Slightly Abridged.*]

(*Concluded from page* 300.)

General Use of Standard-Times in the Foundry

The question of sand blast is somewhat complex and unless the foundry is extremely large it will usually be found better to pay the sand-blast operators a percentage of the earnings of the fettling shop which they supply. Generally speaking, it is found by normal experience that for a particular sized foundry one must have one, two, three or more sand-blast operators continuously at work. If the number becomes considerably higher, then standard times for each casting can be set in exactly the same manner as for dressing or moulding, though naturally they will be lower and will probably be expressed per 100 castings.

In setting times for the preparation of sand and other foundry materials, local conditions will determine the method, though the devices used are similar to those previously mentioned. There is not a job connected with the foundry which cannot be placed upon a reasonable incentive basis.

There is, however, one distinct difference between the individual standard-time set for a moulder as compared with the time set for a group of, say, pourers. The moulder is, within limits, a completely free agent and can continue with his work so long as he has sand and boxes, which means so long as the pouring and knock-out departments are dealing satisfactorily with their sections of the work. If they are not, the moulder immediately communicates with the office in a manner later to be described, and books waiting time, which would be deducted from the bonus earnings of the section causing his delay. In the case of a group of men such as the pourers, no waiting time is allowed, and this means that to ensure the men make money at their job their hours must be regulated by the foreman in accordance with the daily output of the foundry. If the number of moulders be reduced while the number of pourers remains constant, then the pourers cannot possibly earn a bonus unless either their number or their hours be reduced. This is where the foundry foreman should take the necessary action to maintain correct labour balance.

Time Recording and Control

As mentioned earlier in the Paper, time control consists not only of setting time by methods previously described, but also of checking or recording the specified rate of work. A moulder is paid on the number of castings his moulds produce less those number scrapped due to his own faults. Checking the number of castings may conveniently take place after fettling and before they are passed to the casting stores for despatch. Checking times, numbers, weights, etc., usually involve paper work, which is undesirable in any factory department, especially a foundry. Although a certain amount of paper work is necessary, most of it can be avoided, while all the necessary data may still be obtained. Only one paper form need enter the foundry, the remainder being kept in the offices, where they may be suitably handled. In Table IV is shown a "process lay-out." Only the top section refers to the foundry, the lower ones being for use later in the stores and machine shops, and for the present purpose they may be disregarded. This lay-out combines in itself the authorisation for the foundry to produce a certain number of a particular casting. It is first routed to the pattern setter, who obtains and checks his patterns and then passes the lay-out on to the core shop, which commences work and prepares the necessary cores. The standard-time is shown clearly on the lay-out. In the particular example it will be seen that 34 secs. each is the standard-time for making the green-sand cores and 7 secs. are allowed for dressing.

These cores should be ready at the end of the day, when the pattern setter prepares the moulding machine for the next day's work. The cores will be delivered with the lay-out to the moulder whose name has previously been written in by the foreman allocating the job. After moulding, the castings are removed for sand blast, grinding and trimming and eventually, still followed by the lay-out, are passed to the casting stores, where the number is checked. While the castings go to the stores the lay-out is returned to the pay-roll and cost department. Actually, with the three-section type of lay-out shown, the top section only is torn off, the remainder being used for the re-issue of castings to the machine shop when the other standard-times, etc., are utilised.

At this juncture it may well be reiterated that reference is being made to the manufacture of castings in large numbers where runs do not usually exceed a day, but are repeated at frequent intervals. The lay-out form described thus constitutes the order to the foundry, pattern setter, core maker, moulder, dresser and also the receipt of the casting stores for the good castings. It is finally used not only for the payment of all these men, including pourers, casting removers, etc., but also for costing purposes, and it is the only piece of paper which need enter the foundry.

Booking time in foundries is usually regarded as a difficult matter, and is rarely carried out with any degree of accuracy, time sheets and the like being "made up" at the end of the

TABLE IV.—*A Process Layout Form.*

V.S. FLAT TOP BRACKETS — Layout No. 1102 — Issue No. 1

Programme No...3288 — **PROCESS LAYOUT.**

No. Per Model..2 — Date to be Cast..21/1/37

Parts Reqd...120 — No. of Moulding Boxes..30 + 2

No. of Cores..120 — Moulders' Names

Average Weight Each..2 lbs. — Size Box..16 × 10

Type of Machine..Farwell — No. Per Box..4

FOR COST DEPARTMENT ONLY

OP. NO.	DESCRIPTION	DEPT.	LAB. CLASS	STD. TIME OR P. W. E.	O'ATOR'S NO.	REC'D BY
1	Make Green Core	24	J	0. 34.		
2	Bake	24				
3	Dress Core	24	J	0. 7.		
4	Set Patterns and Check					
5	Mould and Cast (11)	23	M	1. 42.		
6	Fettle	22	G	1. 00.		

No. of Fettled Castings.....
No. of Firm's Scrap.....
No. Moulder's Scrap.....
Final Delivery Weight.....

V.S. — Layout No. 1102 — Issue No. 1

Programme No...3288 — **PROCESS LAYOUT.**

No. Per Model..2 — Date of Issue..19/1/37 — Parts Reqd...120

MATERIAL

FOR COST DEPARTMENT ONLY

TOP BRACKET CASTINGS. 4217D — 2 lbs.

Programme No...3288 — **PROCESS LAYOUT.** — Layout No. 1102 — Issue No. 1

No. Per Mould..2 — Date of Issue..19/1/37 — Parts Reqd...120

MATERIAL

FOR COST DEPARTMENT ONLY

TOP BRACKET CASTINGS. 4217D

OP. NO.	DESCRIPTION	DEPT.	LAB. CLASS	STD. TIME MIN.	STD. TIME SEC.	O'ATOR'S NO.	REC'D BY
1	Drill	30	M	1	6		
2A	Set Up	30	M	12	00		
2	Drill and Tap	30	M	1	35		
	Pass to Part Finished Stores						

Part..FLAT TOP BRACKETS — Model..VICTOR V.S. MANGLES

Drawing No. 437 — ALL SIZES

TO BE COMPLETED BY..25/1/37

week with the usual combination of imagination and optimism. This difficulty may be eliminated in a very simple fashion. Fig. 3 shows the time booking centre for a particular factory embodying not only a fairly large foundry, but also machine and assembly shops, wood-working departments, despatch and the usual subsidiary departments of a company producing a finished sales assembly. At the back of the room illustrated there will be seen a loud speaker, and before the girl a microphone. Throughout the factory are a series of simple telephone booths, as shown in Fig. 4. By using one of these telephones in any part of the factory, contact is made with the central control table where one is heard through the loud speaker, communica-

Fig. 3.—Time Booking Centre.

tion the other way being established by the microphone. The start and finish of every job is reported by each individual operator, except in the case of line assembly, where the chargehand speaks.

Recording of these times takes place on cards which are for convenience sake held in folders where the summation of the standard-times against the times taken are shown. It is to be emphasised that every individual on the factory has one of these tickets at the central control table, and he reports the lay-out number and operation number of the job on which he is starting and at the same time mentions the standard-time. On the completion of the job, he telephones through and the time taken is the difference between the times of his calls. Back booking is not permitted. On the completion of his job, he states also the number of parts which he maintains he has completed, which is later checked and usually amended on the return of the lay-out with the official number received by the stores marked thereon. Incidentally, it is to be understood that the finish of one job and the start of the next are one and the same thing, no gap being allowed. If an operator has no next job on which to book, he telephones "waiting time," for which he is paid day-work rate. If he is waiting more than a quarter of an hour the telephone is used to communicate with his foreman, and in any case the waiting time is booked against the department, usually against the foreman's bonus.

As a matter of interest, the table illustrated in Fig. 3 each week handles some ten thousand entries, and, in the experience of the author, a single table can usually handle all the time booking required for a factory employing a thousand operatives, though naturally this depends to a certain extent upon the nature of the work. The telephone system employed is, it is thought, unique and embodies a low-frequency amplifier and no exchange. It would be possible for operators on all the telephones to speak at once, but in practice this does not occur. The normal time for the taking of a reading is 7 seconds. Contrary to what might have been expected, operators do not object to using the telephone and in a very short space of time become remarkably efficient in giving their information.

The advantage of this system is evident, since it keeps paper work in the offices. Furthermore, all information is current, and there is no question of back booking or men waiting for many hours. The depression of a button on the table rings a bell in the particular booth in the shops and at the same time lights a small bulb. It is thus possible for the operator at the central control table to ring to each one of the departments, though this measure is to be regarded as an emergency and not to be normally followed. The system is definitely a special purpose one and does not in any way replace normal inter-departmental telephones.

Planning Foundry Output

Of the foundry producing large quantities of castings, it may be said that the daily output as regards tonnage may be reasonably constant, but exactly when a particular batch of castings will be available is a matter which is usually not capable of being predicted too closely. When castings are supplied for the general trade and rail and road traffic may be blamed, the delay of a day or so is not a serious matter, but when castings have to pass through one's own machine and assembly shops, the matter becomes more serious. In the particular foundry under consideration the following procedure is adopted:—

On the first day cores are made; on the second castings are produced; on the third they are fettled and passed to stores; on the fourth they are machined; and on the fifth they are assembled in complete mechanisms with their attachments, painted and usually despatched. This somewhat rapid progressing is not adopted merely in search of speed, but is necessitated by the bulk of mechanism turned out which renders it impossible to make direct for stock.

Actually, at the end of each week, the orders for complete models—that is to say in the particular instance, mangles, mowers, sports goods, scales, spring balances, etc.—are collected and compared with stock position. From a consideration of these two an assembly programme for the whole week is prepared. From the assembly programme is produced a machining programme, and from the machining programme a foundry programme, the last mentioned being 5 days in advance of the first. The foundry programme is naturally split into component castings for each of which is issued one of the lay-outs previously illustrated and described. These are not, of course, typed out afresh each time, but are withdrawn from files where they are held *en bloc* relating to completed assemblies.

Thus, the foundry manager has in hand a foundry programme showing what should be produced each day, together with a quantity of lay-outs holding all the information for the production of each casting. Each job must then be allocated to each moulder throughout the week, so that the minimum of time is wasted in set-ups and errors, such as the over-use of a particular sized box in one day. The task would, of course, be simple providing it were possible to interchange jobs and moulders as desired, but in practice certain moulders can handle only particular jobs with efficiency.

The best way of planning such a scheme is by means of the horizontal line chart shown in Fig. 5. Since standard-times are available, these may be used in showing exactly how long a job should take. The small section of the chart shows the whole of one week for a few moulders, but this can be extended to cover the complete foundry for longer periods. The top line is the planning line, which shows what should be achieved, and the bottom line is drawn in afterwards, showing the actual achievement.

Fig. 4.—A Telephone Booth in the Factory for Communicating with the Time Booking Centre.

If this be less than the standard time, steps must be taken, or otherwise the programme will break down. This planning may seem somewhat difficult in practice, but nevertheless the foundry does work closely to programme.

It is usually easy enough to keep a foundry busy when orders are plentiful, but planning does more than this—it makes the foundry produce what is wanted at the correct time, meanwhile keeping the men fully occupied. Sometimes the assembly programme demands the impossible, due to a peculiar combination of moulding machines or similar factor. In those cases as soon as the error is discovered the assembly programme itself is modified.

Standard-Costs and Estimates

Much has been written on the subject of foundry costing, and it is not proposed here to deal at all fully with the subject. Some mention must, however, be made of it, since the adoption of standard-times brings one inevitably to what are known as standard-costs. So far as labour is concerned, and assuming errors to be non-existent, a job will always cost the same when performed by an operator of the same hourly rate making a bonus. In practice, how-

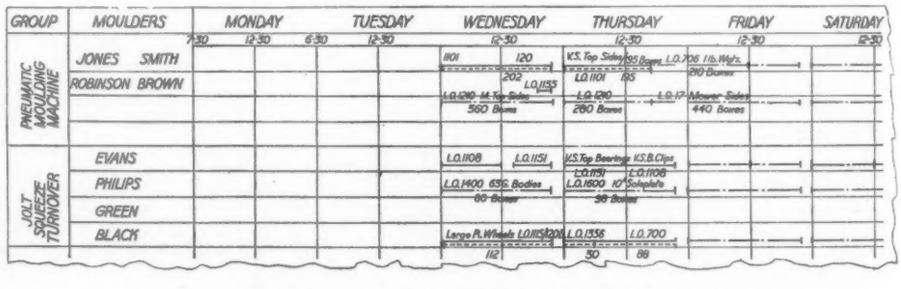


Fig. 5.—A Horizontal Line Chart for Plann ing Foundry Output.

ever, errors are constantly being made. In the standard-cost system the actual cost of any article is measured by what may be called a variation or loss factor. Supposing a particular job takes exactly one hour to perform and the rate is 1s. per hr., then unless something seriously goes wrong the cost of that job will be a shilling. However, the job may be moulded correctly but spoiled in pouring, when obviously its cost must be higher, since it has to be done again.

In standard-costing the perfect or theoretical cost of every article produced is known clearly from the times set and the rates employed. A simple clerical arrangement measures the total labour losses of the foundry which consist of waiting time, lost time through operators "going down" on their jobs, and that time devoted to the replacement or remaking of castings spoiled in the first place. This is considerably more simple than the usual manner, since,

Table V.—*Foundry Standard-Cost for a Casting.*

Description.	Standard-Time.	Operator's Rate. Pence.	Standard-Cost. Pence.
Cores	0.34	6½	0.061
Oven attendant: 17 per cent. of direct core cost	—	—	0.010
Moulding	1.42	10½	0.298
Pouring (4 per box) ..	1.00	11	0.046
Removal	25.00 per 100	10½	0.044
Foundry (indirect cost); 15 per cent. of direct moulding, pouring and removal cost	—	—	0.062
Fettling	1.00	10	0.167
Sand blast; 33 per cent. of direct fettling cost	—	—	0.056
Fixed charges at £3 per ton	—	—	0.643
2 lbs. material, at £5 8s. 6d. per ton ..	—	—	1.255
			2.642

Total standard cost = 2.642d.

Actual cost—		
Labour	0.744	
5.81 per cent variation	0.043	0.787
Material	1.898	
1.43 per cent. variation	0.027	1.925
Total actual cost		2.712d.

fortunately, even in the worst conducted foundries the sum total of scrap is less than that of good castings.

A simple example of the standard-costs is shown in Table V. This is made by combining the completed lay-outs previously described with the completed time tickets. It will be noted that at the end of the standard-cost there is shown a labour loss factor of 5.81 per cent. This latter is determined by finding the percentage of labour losses over total labour. It will be noted that the material cost is shown as £5 8s. 6d. per ton, and this includes pig-iron, scrap iron, sand and all direct foundry materials together with material loss. There are logical reasons for this procedure which will not be dealt with in the present Paper. The method used in estimating follows very similar lines to the standard-cost, as might be expected. Table VI shows an estimate of a simple casting. It will be noted that core making, moulding, pouring, removal and fettling are shown as direct times, and also that a percentage is added to core making time, and to the fettling time. These percentages cover the oven attendant in the case of the core shop and the sandblast operators in the case of the fettling shop. Fixed charges are expressed as £3 per ton, based on the average weekly tonnage.

This method of estimating may appear elaborate when compared with the normal method of adopting a figure per hundredweight dependent upon the type of casting. It is interesting to note that checks on a number of cases show that this method produces results practically identical with those arrived at by an experienced foundry estimator. The advantage of the system is that it can be handled by non-technical men and also that due to being split into a number of factors there is less likelihood of error. Furthermore, it is logical to use this method in connection with the use of standard times and costs.

Relation of Time Control to Mechanisation

Foundry mechanisation may be described as a specialised development of the conveyor principle of manufacture, in which there are a certain number of men in line performing progressive operations which give a final product. A conveyor does two things: (1) it provides a means of transport, thus saving manual labour and (2) by its uniform rate of travel it maintains the time factor and keeps work moving forward at a predetermined rate. Obviously, if the conveyor is properly designed it will perform the first function, but if a conveyor is to show considerable economy in labour the time of the various operations carried out along its length must be approximately balanced as regards time.

If along an assembly line (not in a foundry) there are sixty people, some performing tasks which take one minute, some two minutes, some three minutes, some four minutes and some five minutes, then the total labour loss of that line will be very high. Each position along the line must be balanced to within a few seconds, for it must be remembered that with a correctly balanced line, if an operator waits for one minute the whole line must wait for an equal period. When balanced conveyor systems are running correctly they can produce surprisingly good results, but immediately they go wrong they can waste money faster than any other device of modern production. In the mechanised foundry conditions are neither so stringent nor is correct balance so important, but it must be borne in mind that unless this principle of balance forms a basis of labour allocation then the available economies will not accrue.

Economic Value of Time Control

Nothing is more redundant in industry than technicalities for the sake of being technical. Card systems, microphones and stop-watches may all be useful, but how do they help the manufacturer? Time control, *per se*, when properly carried out will prevent waste labour and will thus automatically effect a cost reduction in any department into which it is introduced. In the experience of the author, idle time in foundries is higher than in any other section of industry so far encountered.

Time control provides a means of gradual though rapid—if the paradox be permitted—improvement. Every time a new moulding machine is introduced a fresh series of standard-times lower than the previous ones is introduced. Each time a pattern is changed to effect simplification, the standard-time is reduced. Since estimates are prepared in a similar fashion the patternmaker when preparing his plate knows that his object is to lower the times set on the estimates. An awkward method of working will raise the standard-time above the estimate.

The actual monetary economies which may be achieved by the full adoption of standard-time control, with the fullest possible support of the foundry management, foreman and chargehands is very high indeed, but it must always be remembered that paper systems, no matter how good, do not in themselves make profit, but only point the way to the elimination of errors and waste.

Apart from the profit-making viewpoint standard-time control provides absolute uniformity of costs with the provision against unstable labour rates and raw material prices. Further, it ensures far better than any other means a fairness of wage payment. Rate fixing can be carried out to a degree when the "good jobs" and the "bad jobs" are almost non-existent. Rigid time-control enables wages to be raised while still maintaining an economic level of costs. Most men will work harder when they realise that extra effort means extra money at the end of the week, and that they are neither being driven nor lured into giving something for nothing.

Difficulties in the Introduction of Time Control

The main difficulty experienced in the introduction of time control in a foundry is the persistent belief in the methods of one's ancestors. In certain sections of industry, rate fixing and its accessories are regarded as essential to manufacture, but in other sections, notably the heavy and basic industries, time control has yet to become an established part of routine. The average working man has a natural objection to the time-study man with his stop-watch, and

Table VI.—*Foundry Estimate for a Casting.*

Description.	Standard-Time.	Operator's Rate. Pence.	Standard-Cost. Pence.
Cores	0.40	7	0.078
Oven attendant: 17 per cent. of direct core cost	—	—	0.013
Moulding	1.40	10½	0.291
Pouring (4 per box) ..	1.00	11	0.046
Removal	28.00 per 100	10	0.047
Foundry (indirect cost); 16 per cent. of direct moulding and removal cost	—	—	0.065
Fettling	1.10	10	0.194
Sand blast; 33 per cent. of direct fettling cost	—	—	0.065
Fixed charges at £3 per ton	—	—	0.643
2 lbs. material at £5 8s. 6d. per ton ..	—	—	1.255
			2.697

Summary—		
Labour	0.799	
6 per cent. contingency ..	0.048	0.847
Material	1.898	
1.5 per cent. contingency ..	0.028	1.926
		2.773
Estimated cost ..		2.773d.

the more skilled is the man the greater will be his objection. This has in the first place to be overcome by tact, firmness and a certain understanding on both sides. The author has found that the average foundryman understands fairness when he appreciates it as such.

The main difficulty in the introduction of time control in the foundry is to obtain the backing of the management, the foremen and the chargehands. There is more than a tendency for them to believe that principles which apply to machine shops, assembly shops, electro-plating, cellulose spraying, the manufacture of biscuits, and even die castings cannot possibly apply to the ordinary foundry. To this attitude it is definitely stated that performance of work in a foundry can be controlled just as well as that in a machine shop.

Before foundries can rank as a modern section of industry, they must study, appreciate and finally embrace time control as essential to their working. There is a vast scope for improvement in the foundry industry to be achieved by the whole-hearted adoption of time control. If, instead of installing an expensive mechanisation, foundrymen were to spend a few hundred pounds and their earnest and active support in the right direction on time control, they would in a few years' time be able to mechanise without a disastrous drain on their resources.

More Non-Ferrous Problems*

By F. DUNLEAVY

Runners, risers and pouring temperatures play a very important part in non-ferrous foundry practice. Fig. 1 shows a leaded bronze sleeve which was cast by means of three ingates. One large riser was used and was placed on the top of the casting, and at the opposite side to the runners. Very often, after the riser had been cut off, such castings required burning up where the riser joined the casting, for here the casting was very spongy.

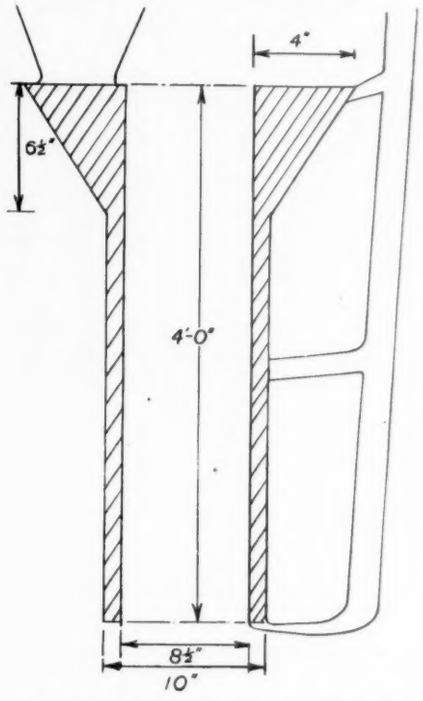


Fig. 1.—Leaded Bronze Sleeve with Riser on Opposite Side to the Three Runners.

Fig. 2 indicates the remedy for this defect. The metal which reaches the riser after being forced through the mould is cold and cannot be expected to feed such a large mass of metal. This riser, therefore, was omitted, and in its place a large tube was placed over the downrunner from the top joint and through the top box. The metal in the runner, being the hottest in the mould, was the last to solidify, and was able to feed the large section next to which it was placed. If the section be very heavy and requires more feeding than usual castings, a dry-sand bush or head may be used to keep the metal fluid for a considerable time.

Centrifugal Casting

Fig. 3 shows a corebox consisting of a bottom half core and one of the top cores of a worm gear blank set up ready for use in the coreshop. With the usual gear blanks of equal section, two coreboxes are used; the bottom core is 4⅓ in. deep, and the top box 1⅓ in. deep. For this type of blank with an internal flange, however, only the bottom box is used. The outside shells of the bottom boxes are built up, and the bottom board is made loose and located by dowel pins. This enables the patternmaker to drop the pattern lower in the corebox by packing between the bottom board and outer ring, thus equalising the thickness or depth of sand between the bottom and top cores.

These coreboxes must fit well, both in diameter and depth. If the cores have too great a diameter, rubbing is necessary, whilst if they are too small, the cores will move during the cast. If the top and bottom cores, when placed together, are too high, a crushed core results.

Fig. 4 shows both top and bottom cores ready for setting up in the machine; it will be noticed that two eyes are rammed up in the bottom cores, and the hooks are shown by which the core is lifted into position. The hole in the top core must be exactly central, otherwise great difficulty will be experienced in casting or pouring the metal correctly.

It is not always possible or convenient to use whole chill rings, particularly when making only a few castings. Loose cast-iron chills are, therefore, used, and a selection of these is shown in front of the cores. These chills, whether whole or in sections, must be hot and dressed, although not so hot as to lose their chilling effect, but sufficiently so to cast without the hot metal cracking the chill. This applies, of course, to the whole ring chill where a sudden expansion will certainly cause much damage.

Fig. 5 shows the bottom core placed in position on the machine. After the top core has been placed in position, the top plate, seen in the background, is added, cottered up, a guard placed over the whole assembly and cast. During the cast the shank or ladle is held in the hook seen suspended from a pair of blocks. This relieves the caster of much weight and enables him to concentrate on the flow of the metal.

Casting Temperature

If the blanks be cast centrifugally at too high a temperature, the casting, when it begins to solidify, sweats in exactly the same manner as a sand casting, and particularly is this so with the type possessing an internal flange; the lighter sections reveal sponginess on machining. If cast at too low a temperature, a drawn place will occur at the joint of each of the four spiral in-gates and the casting. This is due to the runner solidifying before the casting. An interrupted pour will also cause wasters. A full, steady and even flow is essential if one is to obtain sound castings by this method.

When the blank has been cast, it must be given a sufficient length of time to cool, and that time is determined by the section of the casting, usually varying from two to six or seven minutes for a heavy blank. Then the brake is applied and not until the table has ceased to revolve must the guard be taken away.

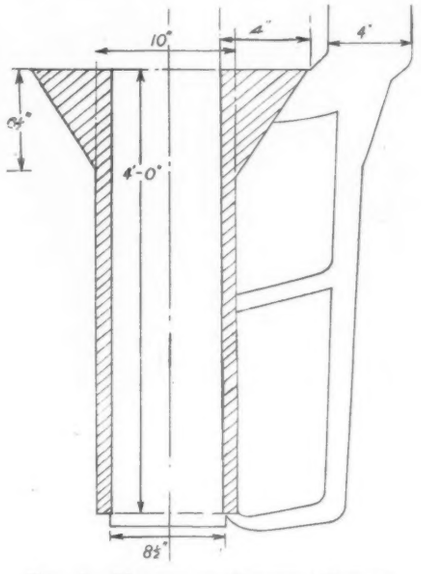


Fig. 2.—Method of Running Casting shown in Fig. 1, so that Defects were Eliminated.

The cotter pins are then knocked out, the top plate removed by means of the blocks on the runway, and two eyebolts are screwed into the chill holding the casting. This chill, together with the core and casting, are hoisted out and lowered on to two pieces of girder 6 in. deep. When the grids are taken out, the core broken up and the casting knocked out, the runners are broken off. Any flash that remains can easily be knocked off at this stage. Castings in this state are shown in Fig. 6.

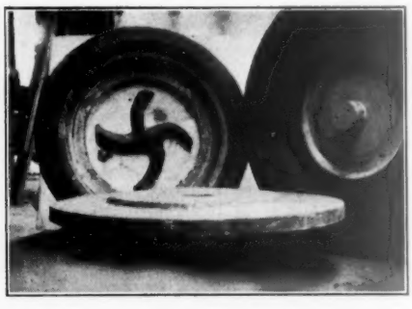


Fig. 3.—Corebox consisting of a Bottom Half Core and a Top Core for a Worm Gear Blank.

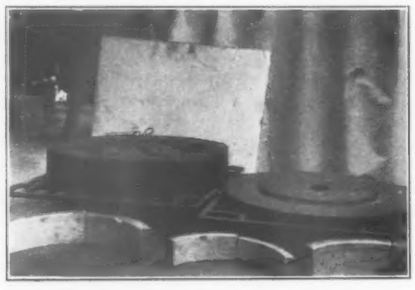


Fig. 4.—Top and Bottom Cores for a Worm Gear Blank Ready for Setting in the Mould.

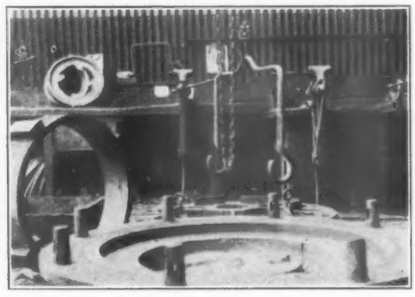


Fig. 5.—Bottom Core of Worm Gear Blank set in Position on the Machine.

Aluminium Alloys

When making an aluminium ring measuring 2 ft. 6 in. outside diameter, 5 in. wide and 4 in. deep, the job is bedded into a bottom box, and the outside of the casting is chilled with

* A Paper read before the Bristol Section of the Institute of British Foundrymen. A Paper on this subject was previously given by the author to the East Midlands Branch and was published in our issue of December 24, 1936. Only sections which were not included in that Paper are published here.

cast-iron chills 3 in. thick. Unless the moulder is very careful, the bottom face of the mould will be hard. The only way to overcome this difficulty is to vent the bottom face with a ⅛-in. vent wire. The top of the vent holes should be covered over very lightly, and an outlet made for the vents at the bottom of the box. If venting be neglected, the casting will have a worm-eaten appearance on the bottom face and will have to be scrapped.

The reason for this poor surface is due to the quantity of air that is held between the particles of sand throughout the mould. When this air becomes heated by the metal in the mould it expands and must be allowed to escape freely and rapidly. The heated air will tend to rise, so that any which is present above the casting will naturally escape through the top part. That below the casting will rise through the molten metal, unless an easier exit is provided elsewhere.

Venting after the pattern has been withdrawn from the mould can only be done when the cast-

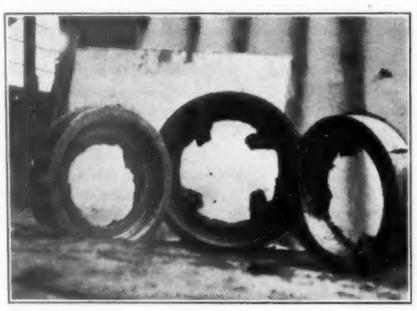


Fig. 6.—Gear Blank Castings.

ing has to be machined on that particular face. In view of the lightness of aluminium and its property of forming a skin of oxide on its surface, it has less ability than most other metals to drive the air from the mould and to fill all the sharp corners. The mould must, therefore, be porous, lightly rammed and vented. All core irons and grids must be kept away from all surfaces.

Ramming really depends upon the nature of the job. Castings of large section will, of course, require more ramming than castings of lighter section. If the mould will hold together that is sufficient, because it will allow more time in stripping, with less fear of cracking.

The runners must be so situated and of such a diameter that the casting cools uniformly. The moulds must be cast quickly, but with as little disturbance of metal as possible.

Catalogue Received

High-Temperature Drying. If we were in business as foundrymen, there is one section of trade literature which would always have our serious attention, and that is the pamphlets and brochures covering the field indicated by the above caption. It presents problems of heat efficiency—which are quite different from drying efficiency—linen hung out on a hot day does not necessarily dry quickly!—and of handling the materials to be dried. Again, in many cases, the cleanliness of the atmosphere is of great importance. The latest contribution to trade literature on this subject is a 12-page catalogue issued by the Sturtevant Engineering Company, Limited, of 147, Queen Victoria Street, London, E.C.4, and the first phase dealt with is air filtration. Following this is an illustration and line drawing of the batch-type enamelling oven for light castings; next is a continuous dipping and drying stove lay-out running at 450 deg. Fah. Stove enamelling is also considered, and a modern plant is illustrated. The brochure is available to our readers on request.

The German Foundry Industry

A recent issue of the Vierteljahrshefte zur Statistik des Deutschen Reiches gives analytical statistics, up to the end of 1935, of the German metallurgical industries, from which the following data relating to the foundry industry have been extracted. Table I gives a survey of the equipment of German foundries as well as the consumptions of pig-iron and scrap and the production of castings for each of the years 1933, 1934 and 1935. Table II gives an analysis of the total production of castings in 1934 and 1935, according to the principal classes of products made.

Table I.—*Foundry Data for Germany*, 1933–35.

	1933.	1934.	1935.
No. of foundries ..	1,242	1,287	1,307
Employment, mid-Dec.	88,222	113,690	131,264
Equipment—			
Cupolas	2,553	2,622	2,659
Air furnaces	95	88	88
O.-H. furnaces ..	57	61	62
Malleable and annealing furnaces ..	630	668	670
Crucible furnaces ..	464	484	442
Electric furnaces ..	37	42	45
Small Bessemer converters	79	84	91
Other melting furnaces	51	60	69
	Met. tons.	Met. tons.	Met. tons.
Consumption of—			
Pig-iron	836,318	1,297,592	1,596,679
Scrap	697,359	1,106,921	1,304,109
Total castings produced	1,405,419	2,233,030	2,706,656

It is shown that the output of the German foundries in 1935 was 21 per cent. higher than in the previous year, the territorial distribution of production in 1934 and 1935 respectively being as follows: Prussia, 70.0 and 66.1 per cent. (of which 26.7 and 26.1 per cent. of the total respectively were contributed by the Rhine Province, and 16.5 and 15.6 per cent. by Westphalia); Saxony, 7.8 and 7.9 per cent.; Bavaria, 7.0 and 6.6 per cent.; Saar, nil and 5.4 per cent.; Baden, 4.9 and 4.5 per cent.; Wurtemburg, 3.2 and 3.3 per cent., and the rest of Germany, 7.1 and 6.2 per cent. It is evident that the return of the Sarr was responsible for only a small part of the total Reich increase in castings output.

Table II.—*Production of Castings in Germany in* 1934 *and* 1935.

(In metric tons.)

Product.	1934. Output.	1934. Percentage of total.	1935. Output.	1935. Percentage of total.
	Met. tons.		Met. tons.	
Crude castings, total	1,948,116	87.2	2,370,591	87.6
Engineers' castings	775,477	34.7	987,052	36.5
Hearth and range castings	117,845	5.3	111,454	4.1
Pipes	255,491	11.5	349,846	12.9
Builders' castings	65,711	2.9	83,377	3.1
Rolls	74,111	3.3	89,229	3.3
Radiators and boilers	215,951	9.7	206,418	7.6
White-iron castings	13,056	0.6	12,493	0.5
Brake blocks	63,462	2.8	63,908	2.4
Firebars	42,015	1.9	56,053	2.1
Chills and ingot moulds	205,751	9.2	271,215	10.0
Other castings	119,244	5.3	139,546	5.2
Enamelled and other finished grey castings ..	105,018	4.7	102,480	3.8
Malleable castings	75,005	3.4	88,360	3.2
Steel castings	104,891	4.7	145,225	5.4

Regarding the consumption of raw materials, the returns indicate that only 2 per cent. of the pig-iron consumed was foreign, the rest being produced in Germany. The relative proportions of scrap and pig-iron consumed have remained almost the same for 1934 and 1935, and in the latter year scrap accounted for 45 per cent. of the total charge worked. Scrap consumption of the whole iron and steel industry has nearly doubled, being 4,420,000 metric tons in 1933 and 8,125,000 tons in 1935. Steelworks have accounted for approximately 75 per cent. of the total in each year, foundries for between 15.8 and 16.7 per cent., and the blast furnaces for between 6 and 9 per cent., the higher figure applying for 1935.

Air-Flow Measurement

For some years now the British Compressed Air Society has published a pamphlet outlining the method by which the free air delivered by a compressor should be determined. In order to secure wider recognition of the method, it was submitted to the British Standards Institution with a view to its adoption as a British Standard. A competent and representative Committee was appointed to consider the question, and the results of their labours have been embodied in the B.S. Specification, No. 726—1937: Method of air-flow measurement to obtain the free air delivered, which has just been issued.

The specification describes in full the lay-out of the pipe line, an interesting feature of which is the use of a perforated plate to secure uniform flow as a result of which the length of the pipe line has been appreciably reduced from that which would be necessary without it. The measurement of the flow is determined from the pressure drop across a nozzle inserted in the air stream. The form of the nozzle conforms to the well-known I.G. nozzle. A table is included setting out the relationship between the pipe diameter and the nozzle size over a wide range.

For small installations, where a nozzle less than 1 in. dia. is required, the design has to be slightly modified, for mechanical reasons, and the specification includes special designs for a ¾ and ⅝ in. nozzle. For nozzles of sizes above 1 in. the form is the same design.

A detailed description of the measurements and calculations necessary to determine the free air delivered by a compressor is given. The derivation of the formula used for calculating the quantity of air and the values assigned to the constants are explained in an appendix. The standard test is made under conditions when the air is discharged to the atmosphere, but an alternative arrangement can be used whereby the measurements are made under pressure. Comparative tests were made which showed that the results obtained by the two methods were in close agreement.

The Specification (No. 726—1937) may be obtained from the British Standards Institution, Publications Department, 28, Victoria Street, London, S.W.1 (price 2s. 2d., post free).

Silica Refractories

Before a recent meeting of the Midland Section of the Coke Oven Managers' Association, in Sheffield, Mr. W. J. Rees (Lecturer in Refractories at the University of Sheffield), read a Paper on "The Silica Refractories: their Production and Properties." In the course of his remarks he pointed out that in regard to the manufacture and the use of silica bricks, there was the change from quartz to tridymite or cristobalite. As to whether tridymite or cristobalite was formed depended a good deal upon the presence of materials other than silica. If the material was pure and was heated the change was one to cristobalite mainly. But if there was some material present, either from added bond or formed by the small proportion of impurities present in the rock, then some of the change took place to tridymite. Although cristobalite might not be the stable form in that range, it would be formed in preference to the stable form, which in that particular temperature range would be tridymite. Quite a good deal of the research work of recent years had been with the object of facilitating the production of tridymite during the burning of silica brick rather than of cristobalite. Besides the changes in volume due to direct inversion from quartz to cristobalite or tridymite, the two forms tridymite and cristobalite had their tantalising volume changes. If they formed cristobalite by heating these rocks and allowed it to cool down it did not revert to quartz but if they re-heated it it passed through a volume change and there was a change in crystalline form at quite a low temperature, 240 deg. C., and when that change took place there was a sudden expansion of approximately 1 per cent. Tridymite had an inversion at about 140 deg. C. but that was accompanied by only a very small volume change, approximately 0.1 per cent., so it would be seen there was one reason why it was desirable to have the crystalline silica in the brick as tridymite rather than cristobalite. Quartz itself had a change point which had to be taken care of in the burning of silica bricks. The ordinary form of quartz as they used it changed at 575 deg. C. to the beta form of quartz, which again was a volume change and there was an expansion of approximately 0.4 per cent.

This change from quartz to tridymite or cristobalite, continued the speaker, required prolonged heat to be effected completely. But the change in crystalline form from alpha to beta quartz, cristobalite or tridymite, was a very sudden change, and when the inversion temperature was reached "over it went." It was a sudden and complete change at the inversion temperature. That was so well recognised in regard to alpha and beta quartz that it had been very carefully measured. It was at 573.2 deg. C. and it was such a definite point that it was now one of the calibration points on the international thermometer. He would emphasise the implications of that sudden change in regard to the use of bricks.

Regarding the burning of silica bricks, the speaker said that if it had been thoroughly conducted, as it was in the majority of works in this country nowadays, the quartz had all gone, the silica was present as cristobalite and tridymite, and they had a glassy matrix, the lime-alumina silicate, which must be cooled uniformly and slowly, especially when the brick was very nearly cold, *i.e.*, when it was passing from 300 to 200 deg. C. If they let a brick get a cold draft on it in that narrow temperature range it would crack it or set up a strain which would only very slowly be removed and which might lead to subsequent cracking of the brick. So slow cooling was really essential. There had been interesting experiments going on during recent years with other types of bond. If they could produce a bond which would be as satisfactory as lime in facilitating the inversion of the quartz and which would, at high temperatures, have a higher viscosity than lime bond, the brick might have some advantages over the lime-bonded brick. During the past two years or so, some interesting work of commercial importance had been carried out by American silica-brick makers with a new form of bond. He believed a large number of silica bricks had been made with barium aluminate replacing the ordinary lime bond, but it was difficult to get any really accurate information as to the behaviour of these bricks in service.

If they could obtain their silica entirely as tridymite some of the difficulties met with in the use of silica bricks would be decidedly reduced in their general incidence. Because of that, a good deal of research work had been in the form of trying to increase the tridymite by the use of a catalyst. They made bricks to which they added small quantities of iron oxide and they obtained an enormous increase in the rate of production of tridymite, without altering the burning of the brick, so that now there were many manufacturers who actually added iron oxide in some form or other to their silica-brick batch in order to get the desired increase in the tridymite content of the brick. Bricks were being made in the Sheffield district which contained a little added iron oxide and in which the tridymite content was certainly above 70 per cent. of the crystalline silica content of the brick. That represented a very definite advance.

West Yorkshire Foundrymen Visit Doncaster Brassfoundry

The West Riding of Yorkshire Branch of the Institute of British Foundrymen last month paid a visit to the works at Doncaster of Peglers, Limited, one of the largest undertakings in the country engaged in the manufacture of plumbers' and engineers' brass work. There was an attendance of between 70 and 80, including several visitors from Lincolnshire. The Branch-President (Mr. Joseph Hepworth, M.P.) was unfortunately prevented from being present, but sent a message of regret and good wishes.

The Pegler undertaking was founded in 1899 by the present managing director, Mr. F. Birchall, in some small buildings in the centre of Doncaster. The accommodation was very quickly outgrown and the firm moved in 1904 to the present site. Since that time there has been continual progress and expansion, so that to-day employment is found for more than 1,500 people. The works produce only non-ferrous products and include a large foundry, the metal for which is supplied by 3-ton reverberatory oil-fired tilting furnaces. An extruding shop with two 600-ton presses, a large battery of automatics, and a hot-pressing shop which absorbs the product of the extruding shop are also included in the works. All the bar extruded is used on the premises, as are all the hot pressings.

The extruding presses and the automatics, as well as the stamping presses, were demonstrated in action, as were the chucking automatics, all with individual drives, which give very fast production rates. The main machine-shop is a large building with twelve bays. No demonstrations were arranged here, but the visitors were able to get some idea of the diversity of the company's manufactures. After inspecting the machine-shop the party divided into four sections, which were conducted by Mr. A. Crowther, Mr. C. M. Smith, Mr. H. Brown and Mr. F. Bark through the assembly, polishing and plating shops. In the tool shop, where a staff of more than 100 are employed, a demonstration was arranged on the Keller automatic die-sinker. The tour concluded with a visit to the metal recovery plant, which handles all the foundry ashes, sand, spillings, road sweepings, etc.

Prior to the tour the visitors had listened with great interest to a talk by Mr. C. M. Smith on the works and their processes and products. The visit concluded with afternoon tea served in the new large and modernly-equipped canteen at the works, after which Mr. Smith answered a number of questions arising out of his talk and the inspection of the works.

Thanks to the company for their hospitality and facilities for the visit, and to the guides for their helpfulness, were expressed by MR. S. W. WISE (hon. secretary of the Branch) and seconded by MR. F. K. NEATH (immediate past Branch-President). MR. C. M. SMITH (works manager) and MR. CROWTHER (chief metallurgist) responded, and complimented the Branch on securing such a large attendance in spite of the very bad weather conditions.

VIEW OF THE BRASSFOUNDRY OF PEGLERS, LIMITED.

THE FOLLOWING DIRECTORS of John Harper (Meehanite), Limited, have been appointed:—Messrs. John Howard Harper (chairman), David Lewis, Samuel Mills Slater, Wilfrid Holland Harper, Herbert Field and Gordon J. Brooks (secretary).

Some Problems Involving the Accuracy of Machine-Moulded Castings*

By A. H. SQUIRE

Apart from the question of mass-production in the accepted meaning of the words, machine moulding has other obvious advantages over hand moulding. Not least among them is the use made of semi-skilled labour, and many firms use this means of producing comparatively small batches of castings. The extra cost of patternwork is offset by lower foundry costs, and although the total cost may not be lower, the practice leaves skilled moulders free for other work and assists production.

Obviously the accuracy of patternwork must be above reproach if machine moulding is to be a success, and whilst a quality of pattern (made in consideration of the number of castings required) may be used, the accuracy of mounting must be the same, irrespective of the number off.

Consider first the two principal methods used in mounting wood patterns on plates, where reference, of course, is made to jobs where "matching" is necessary. One way is to mark centre lines on the plate, set out guide lines for the pattern and fix the two parts of the pattern either by means of screws or adhesive. Another method is to make a plywood template the size of the moulding plate and cut two holes to match the pin holes. One half of the pattern is held in position on the plywood and the profile scribed on, this portion being cut away, which leaves a hole into which either half of the pattern will fit, depending on which side of the plywood it is inserted. The template is placed on the plate, two base pins inserted to keep it in position, and half of the pattern set and fixed. The plywood is removed, turned over through the appropriate centre-line and either replaced or put on a second plate, the other half pattern being inserted and fixed in position. Either of the foregoing methods carried out by a skilled patternmaker should produce an accurately matched casting.

A trial mould is made and the casting examined for faults, any overshot or cross-jointing being reported to the patternmaker, who is instructed to adjust the pattern and a further sample is made.

The second sample is sometimes overshot in the reverse direction by a fair amount, often by more than the pattern has been moved (patternmakers usually scribe the plate to witness the amount of adjustment made). When results are satisfactory, production proceeds.

When a machine breaks down, it is often necessary to transfer the plate to another, and it is not uncommon to find that the job which previously was satisfactory is giving far from good results. Usually this phenomenon is dismissed with the remark that "no two machines are quite alike" and the plate is returned for adjustment.

Another problem is the job which has been in use for years and suddenly gives trouble. The patterns have not moved, but the castings are not good enough, and so the plate must be returned for adjustment.

Moulding Machine Adjustment

Consider a number of similar moulding machines, supplied by the same maker. They are made to take a standard-size moulding box, located on them by pins fixed either to the plate or machine. The boxes must be interchangeable; therefore, the centres of the pins must be true within close limits.

With only a slight mechanical knowledge, it should be apparent that if a plate and moulding box will fit any of these machines, the results should be the same whichever is used, and that if the distance between the centres of the locating holes varied to the extent of the overshot sometimes obtained, the moulding box would at once disclose the trouble by refusing to fit on the machine.

An investigation conducted to find the causes of the foregoing troubles produced the following results.

All machine and setting pins were examined, and some of them showed variations up to $\frac{1}{32}$ in. in diameter, while some were slightly bent. Then the moulding boxes were tested with pins of standard diameter, with the result that some would not take the pins and others gave a loose fit.

In a properly supervised foundry this state of affairs should be impossible; unfortunately, it does exist in many foundries, and is largely due to the practice of some moulders of retaining old pins which officially have been scrapped. When a box gives a little trouble, the moulder gets out the old pins, and if they are "easier" he often continues to use them indefinitely. Whether the pin is much undersize or out of true, they do not know; to them it is "a pin," and if it makes the job easier, they use it. The way to prevent this practice is to institute a regular weekly system of examination of all moulding boxes and both machine and setting pins.

All old pins should be collected, tested, replaced where necessary, and when re-issued should have a distinguishing number marked on them. A list of these numbers should be issued to the foreman, who will be able to check up at any time and discover if unauthorised pins are being used. A man should be appointed to collect all pins once a week (after working hours) and test them for size and truth. Any inaccurate ones should be replaced by others kept in stock, the list of numbers being amended accordingly. This practice will also give some indication if certain workmen are unduly careless with the pins issued.

Firms having a tool or machine shop will have little difficulty in making this arrangement, but in other cases the foreman could be supplied with gauges for diameter, and a small lathe to test for straightness. When spinning the pins in the lathe, it would be a simple matter to polish them, using a piece of leather glued on to flat wood and a little polisher's rouge mixed with oil; this weekly polishing would remove any roughness due to exposure to damp, etc.

Proposed Standards

The following standard sizes for pins are suggested as suitable for adoption:—Pins to Newall Class "X" limits, + 0.00125 in. and − 0.00275 in.; plates and boxes to Newall Class "B" limits, + 0.00075 in. and − 0.0005 in.

Another cause of trouble is the machine plate made to the wrong thickness or badly bored. Firms having their own pattern shop should supply a gauge for testing, and make it a routine matter that all plates, either of their own make or purchased outside, should be tested before use. In other cases the foundry foreman could arrange to test before use any plates received.

Finally, it is suggested that a standard pair of moulding boxes with box and setting pins be kept, under lock and key, to be used only for making trial moulds. The boxes selected should

(*Concluded in next column.*)

(*Concluded from previous column.*)

have holes bored to the lower "Class B" limit − 0.0005, and the pins ground to the higher "Class X" limit − 0.00125; this should provide a fair standard which the patternmaker must accept when checking a trial casting and an incentive to the foundryman to keep his plant in good order.

* Winning entry in a Short Paper Competition held under the auspices of the London Branch of the Institute of British Foundrymen.

Spectroscopic Analysis

SPEKKER STEELOSCOPE

At the Second Conference on Industrial Physics held at Birmingham on March 18, Prof. A. Fowler, C.B.E., F.R.S., took as the subject of his presidential address "Spectroscopy in Industry" and said that although spectroscopic methods of analysis were now finding useful applications in numerous industrial establishments, there could be little doubt that if the simplifications which were now available were more generally known, these methods would be far more widely adopted. It was not to be expected that ordinary chemical analysis would ever be entirely superseded, but for many purposes, spectroscopic tests would give all the information required, and in other cases would often effectively reduce the work of the chemist. Moreover, spectroscopic methods had a great advantage in the rapidity with which an analysis could be carried out, and in indicating, with comparatively few exceptions, all the elements which were present in a sample, even to minute traces.

The speaker then proceeded to give an account of some of the methods of spectrum analysis, with special reference to instrumental and other simplifications which had been introduced, and some examples of their application to practical problems. Qualitative analysis, continued the speaker, was comparatively simple and had been greatly facilitated by the introduction of spectroscopes by which the wave-lengths of the spectrum lines could be read off directly. A striking example of a simplified spectroscope was the Hilger "Spekker Steeloscope" for the rapid testing of steels. The identification of an element with this instrument merely involved a setting which was about as simple as the setting of a wireless receiver to a desired station. Spectrum analysis could scarcely be simplified further, and as this instrument was also applicable for approximate quantitative estimations, it was not surprising that it had found its way into many industrial laboratories. A much wider field could be covered by photographic methods, using such an instrument as a quartz spectrograph. With a little training, an intelligent laboratory assistant could be entrusted with the experimental work, leaving the examination to the convenience of the physicist or chemist in charge.

The Spekker Steeloscope, which could also be adapted for non-ferrous metals, was now extensively used for the determination of the quality of scrap metal.

Japanese Pig-Iron Purchases

It is reported from Tokio that the Japan Iron Company have succeeded in contracting for the importation of an extra 88,000 tons of American and Canadian pig-iron for delivery during 1937. The present contracts involve 35,000 metric tons of Canadian pig-iron, and 3,500 metric tons of American pig-iron for casting purposes and 50,000 metric tons of American pig-iron for steel making. These will be the first imports of Canadian pig-iron into Japan. The company has already imported 100,000 metric tons of foreign pig-iron, including 5,000 tons of French pig-iron and 95,000 tons of American pig-iron, since the end of last year through the Mitsui and the Mitsubishi companies.

The Week's News in Brief

Trade Talk

Turner & Newall, Limited, are to establish an asbestos cement factory in Scotland.

Vickers-Armstrongs, Limited, are to give their employees a holiday with pay on Coronation Day.

Hathorn, Davey & Company, Limited, Leeds, have secured an order from Istanbul for pumping plant to the value of £29,000.

The scope of the Finnish decree prohibiting the export of scrap iron from Finland has now been extended to all scrap metals.

Sir Gordon Ley, the governing director of Ley's Malleable Castings Company, Limited, recently presented fourteen long-service awards to employees. It was announced that all employees would be paid for their holiday on Coronation Day.

The annual dinner of the Staffordshire Iron and Steel Institute (Association Section) was held in Wednesbury last Friday. Mr. J. G. Pearce, director of the British Cast Iron Research Association, proposed the toast of the iron and steel trades.

The highest level of output in mercantile tonnage since the war has now been reached on the Clyde. The figures for the first quarter of the year are 26 vessels, of 72,460 tons, compared with 14 vessels of 67,141 tons for the corresponding period last year.

The Southern Railway Company have ordered two boats from Denny Bros. & Company, Limited, Dumbarton. One of the boats is to be rudderless and will be the first of this type in this country. She will be operated by a new form of propulsion of German origin.

The merger is announced of two Welsh tinplate companies, the Old Castle Iron & Tinplate Company, Limited, and the Western Tinplate Works, Limited, who both own works at Llanelly. Shareholders in the Western Company are to receive five Old Castle £1 shares for nine of theirs.

An extraordinary general meeting of members of the Institute of Welding, Limited, is to be held in the offices of the Institute, 104, Victoria Street, London, S.W.1, at 3 o'clock, on April 28, 1937, for the purpose of altering the composition of the Council and dealing with other related business.

The Blythswood Shipbuilding Company, Limited, Scotstoun, Glasgow, are to build a 12,000-ton motor tanker for the Eagle Oil & Shipping Company, Limited, London. The propelling machinery, which is to be of the Harland-B. & W. type, will be supplied by John G. Kincaid & Company, Limited, Greenock.

The foundation stone of the £3,000,000 iron and steel works which are to be constructed at Karabuk, in Central Anatolia, for the Sumer Bank by H. A. Brassert & Company, of London, was laid recently by the Turkish Prime Minister, who spoke of the great importance of this enterprise in its relation to the industrial development of Turkey and in its bearing on national security.

The London Passenger Transport Board announce that owing to the recent increase in price of steel it will be unable to carry out the proposed extension to Camberwell of the Bakerloo line. It is estimated that the cost of building a tube has recently increased from £750,000 to £1,000,000 a mile; the rise in price of steel is a dominant factor.

A lecture on the life and work of Dr. Thomas Newbigging was given at the Central Library, Manchester, on April 3, by Mr. L. M. Angus-Butterworth, A.M.I.Mech.E. Dr. Newbigging, who was born in Glasgow in 1833, gained an international reputation as a gas engineer and was one of the founders of the Institution of Gas Engineers, of which he became the President. He died in 1914 in his 81st year.

The twenty seventh annual May lecture of the Institute of Metals will be delivered by Prof. E. N. da C. Andrade, D.Sc., Ph.D., F.R.S., on Wednesday, May 5, at 8 p.m. The lecture, entitled "The Flow of Metals," will be given in the hall of the Institution of Mechanical Engineers, Storey's Gate, Westminster, S.W.1. Tickets of admission can be obtained from Mr. G. Shaw Scott, 36, Victoria Street, London, S.W.1.

A demonstration of electrical pyrometer equipment and heat-treatment plant by the Foster Instrument Company, Limited, Letchworth, and Wild-Barfield Electric Furnaces, Limited, London, with the co-operation of the North-Eastern Electric Supply Company, Limited, was opened yesterday at the power demonstration room, Carliol House, Newcastle-upon-Tyne. It will remain open to April 23, excluding Saturday and Sunday, April 17 and 18.

The General Electric Company of China, Limited, has received a contract for the installation of trolley 'buses in Canton. All the electrical equipment will be manufactured in England by the General Electric Company, Limited, and its subcontractors. The chassis of the 70 single deck trolley 'buses which have been ordered will be made by Leyland Motors, Limited, of Leyland, Lancs, and the 80 h.p. series motors by the G.E.C. at its Witton Engineering Works, Birmingham.

Female workers employed in foundries in Willenhall and the surrounding district will benefit as a result of a wage increase for the district which has been announced by Mr. George Matthews, district organiser of the engineering and foundry section of the National Union of General and Municipal Workers. As a result of a conference between the Willenhall and district ironfounders and manufacturers and the Union, an offer was made of 2s. 6d. per week increase on the existing agreement to all women of 18 years and over, 2s. per week at 16, and 1s. under 16 years. These proposals were submitted to a large meeting of women foundry workers who unanimously accepted them. The new rates became operative from April 1.

Personal

Mr. E. G. Sherratt has been appointed buyer for Bamfords, Limited, in succession to Mr. J. Doran, who retired recently.

Mr. James McKay has been elected a director of British Insulated Cables, Limited, to fill the vacancy caused by the resignation of the Hon. Sir Arthur Stanley, G.B.E.

Major J. M. Aiton, son of Sir Arthur Aiton and a director of Aiton & Company, Limited, pipe manufacturers, of Derby, is on a business tour of the United States and Canada.

Mr. R. A. Jones, the newly elected President of the Lancashire Branch of the Institute of British Foundrymen, is at present in a nursing home at 31, Anson Road, Manchester, 14.

Mr. R. Waddell, who was for 18 years general manager of Brown, Bayley's Steelworks, Limited, Sheffield, has joined Campbell & Gifford, consulting engineers, 17, Victoria Street, London, S.W.1.

Mr. T. G. Rose, M.I.Mech.E., M.I.P.E., F.I.I.A., has been appointed general director of the National Institute of Industrial Psychology to collaborate with Dr. C. S. Myers, C.B.E., F.R.S., the principal.

Mr. Robert Richardson and Mrs. Richardson have celebrated their golden wedding at their home in Gateshead-on-Tyne. Mr. Richardson, who is 74 years of age, was a moulder at the works of Clarke, Chapman & Company, Limited, Gateshead, and retired about six years ago.

Mr. Peter Bennett has been appointed Deputy-President of the Federation of British Industries, to assist Lord Hirst in the execution of his duties. Mr. Bennett, who is a managing director of Joseph Lucas, Limited, has been for some years a member of the Federation's Grand Council as well as chairman of the F.B.I. Birmingham District Committee. As a member of the Empire Committee, also, he has been closely connected with imperial trade problems.

Mr. J. Jermyn Pritty, after a lifetime's association with the E. W. Bliss Company, the well-known manufacturers of presses, of 6, Pocock Street, Blackfriars Road, London, S.E.1, has resigned his position as managing director. His services are, however, to be retained in a consulting capacity. Mr. Pritty had a serious illness some twelve months ago, and though now completely recovered, he feels that a lessening of activities would best preserve his health.

Mr. S. F. Ferguson, director of the Australian Association of British Manufacturers at its head office in Melbourne, will arrive in London early in May, and will be available at the London office of the Association until the autumn. Mr. Ferguson's work in Australia on behalf of British trade in connection with tariff and other matters is well known to manufacturers in this country, who will realise the advantages to be derived from this opportunity of making personal contact with him.

Contracts Open

Darton, April 17.—1,219 yds. of 4-in. spun-iron water pipes, for the Urban District Council. Mr. P. Wilkinson, waterworks engineer, Council Offices, Darton, near Barnsley.

Dublin, May 3.—Cast iron, spun iron, or steel pipes, ranging from 60-in. to 9-in. dia., for the Town Council. The City Treasurer, Exchange Buildings, Lord Edward Street, Dublin. (Fee £1 1s., returnable.)

Guildford, April 19.—1,820 yds. of 10-in. dia., and 3,955 yds. of 7-in. dia. spun-iron water main, for the Town Council. Mr. J. W. Hipwood, borough engineer, Municipal Offices, Guildford. (Fee £2 2s., returnable.)

London, W., April 29.—375 cast-iron short base lamp columns, for the Kensington Borough Council. The Borough Engineer, Town Hall, W.8.

Newton Bar, April 27.—9,151 yds. 2-in. cast-iron water main; 16,580 yds. 3-in. spun-iron water main; 538 yds. 4-in. spun-iron water main, for the East Kesteven Rural District Council. Mr. E. H. Sills, engineer, Council Offices, Northgate, Sleaford.

Simla, May 17.—Cast-iron wash basins, etc., for the Indian Stores Department. The Department of Overseas Trade. (Reference T 31,271.)

New Companies

(From the Register compiled by Jordan & Sons, Limited, Company Registration Agents, 116 to 118, Chancery Lane, London, W.C.2.)

Electro-Metallic Recovery Company, Limited, Green Walk, Tower Bridge Road, London, S.E.1.—Capital, £10,000.

Stourvale Products, Limited.—Capital, £5,000. Iron and brass founders, engineers, etc. Directors: J. Oakley, "Berken," Iverley, Stourbridge, Worcs.; Mrs. L. Oakley.

Oakley Bros., Limited.—Capital, £40,000. Iron and brass founders, general engineers, etc. Director: J. Oakley, "Berken," Iverley, Stourbridge, Worcs.

R. Reason & Sons, Limited, 243, Southwark Bridge Road, London, S.E.1.—Capital, £3,000. General engineers, founders, etc. Directors: T. A. Reason and A. R. Reason.

Obituary

Mr. James Dickson, for many years foundry manager and director of Allison Bros., ironfounders, of Glasgow, died recently.

Mr. William Tannock, who for 18 years was foreman at the Ardeer Foundry Company, Stevenston, Ayrshire, died on April 6, aged 87.

The death has occurred, at the age of 65, of Mr. Percy William Allday. He was chairman and managing director of the firm of William Allday & Company, Limited, a business that he founded in 1922, and was at one time director of Allday & Onions, Limited.

Mr. Clifford Dixon, a director of S. Dixon & Son, Limited, brassfounders, of Swinegate, Leeds, died on April 6. Mr. Dixon was a descendant of John Dixon, who founded the firm at Wolverhampton in 1730. The undertaking was transferred to Leeds in 1825.

The death has occurred of Mr. J. Simpson, foundry manager of Brown Bros. & Company, Limited, Rosebank Iron Works, Edinburgh. Mr. Simpson joined the firm in 1906 as foreman pattern-maker. He was an active member of the Edinburgh section of the Scottish Branch of the Institute of British Foundrymen.

Forthcoming Events

APRIL 19-24.

International Association for Testing Materials:—International Congress in London.

Institute of British Foundrymen

APRIL 17.

Lancashire Branch:—Annual meeting and dinner at the Pack Horse Hotel, Bolton, at 5.30 p.m.

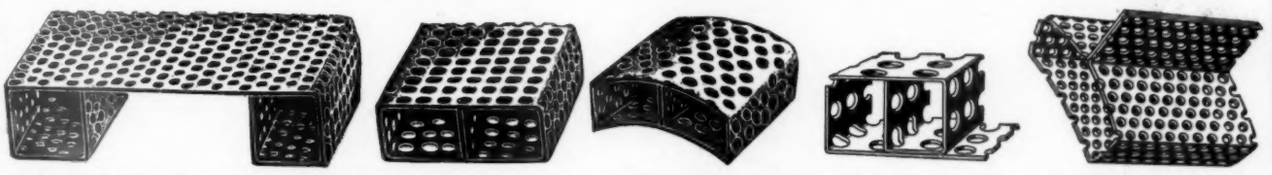
APRIL 24.

West Riding of Yorkshire Branch:—Annual general meeting, at the Technical College, Bradford, at 6.30 p.m.

CHAPLETS & STUDS

FOR EVERY BRANCH OF FOUNDRY INDUSTRIES

PERFORATED CHAPLETS. ALL SHAPES—SIZES—AND THICKNESSES



PRECISION HYDRATITE STUDS & CHAPLETS FOR ALL CYLINDER CASTINGS

SEND US YOUR ENQUIRIES.

WE CAN QUOTE YOU RIGHT.

LARGE QUANTITIES OF STANDARD SIZES STOCKED.

ALSO MAKERS OF

DOOR CATCHES, HINGE TUBES & DOVE TAILS FOR THE GENERAL STOVE & RANGE TRADES.

SKIMMING GATES.

TOP HAT CHAPLETS.

CORE WIRES, PLAIN & TWISTED,

& ETC.

USE PRECISION STUDS AND CHAPLETS FOR BETTER RESULTS.

PRECISION PRESSWORK CO.

—PATENTEES—

'Phone: Aston Cross 1402.

'Grams: Precico, Phone, Birmingham.

CLIMAX WORKS, COLESHILL STREET, BIRMINGHAM 4.

ESTABLISHED 1874

WARNER Special PIG IRONS

- Warner C.B.R. and Low Carbon Cylinder (FOR CYLINDERS, ROLLS, ENGINEERING CASTINGS, ETC.)
- Low Carbon Malleable (FOR MALLEABLE CASTINGS OF ALL DESCRIPTIONS)

Supplied to any specification between limits of 2·00 and 3·50% Carbon and ·50% and 3·50% Silicon

● ACTUAL ANALYSIS CERTIFICATES ARE AVAILABLE WITH EACH DELIVERY

● **Typical Cylinder Pig Iron Specification**

TOTAL CARBON	2·70%
SILICON	1·80%
MANGANESE	·90%
SULPHUR	·06%
PHOSPHORUS	·40%

● **Typical Malleable Pig Iron Specification**

TOTAL CARBON	2·60%
SILICON	·75%
MANGANESE	·50%
SULPHUR	·05%
PHOSPHORUS	·06%

WARNER & CO. LTD.
CARGO FLEET · MIDDLESBROUGH

Raw Material Markets

The question of prices continues to dominate all aspects of the iron and steel industry. Costs of production are steadily increasing and the burden of additional primary expenses cannot be borne by producers indefinitely. As far as steel prices are concerned, an early revision is generally anticipated. The delay in announcing the new prices of scrap under the scheme of control continues to restrict business, but it is generally believed that the scheme will be fully in operation in the near future.

Pig-Iron

MIDDLESBROUGH.—In spite of the heavy demand for pig-iron from home consumers, the needs of the export market are not being neglected. Makers have no immediate prospects of being able to entertain new business and prices remain nominal and unchanged. Attention is centred around the increase of outputs. The export trade in hematite, also, has not been overlooked entirely, and some quite substantial tonnages have recently been despatched. Makers have disposed of their outputs up to the end of June, and are not at present inclined to book orders beyond this period. East Coast hematite mixed numbers are quoted at 97s. 6d. on the North-East Coast, 103s. in Sheffield and 108s. 6d. in Birmingham. The foregoing figures are subject to 5s. per ton rebate.

LANCASHIRE.—Every effort is being made by producers in this area to maintain deliveries on a satisfactory basis, but arrears appear to have increased. For delivery to users in the Lancashire price zone, offers of Staffordshire and Derbyshire No. 3 foundry iron are on the basis of 89s. per ton, with Northamptonshire iron at 87s. 6d., and Derbyshire forge at from 84s. to 86s., according to the class of consumer. The shortage of hematite is still more acute and deliveries generally are far behind schedule. West Coast iron is quoted at 106s., with East Coast material at 105s. 6d., subject to 5s. per ton rebate. Scottish No. 3 iron is at 106s. per ton, delivered to the Manchester area.

MIDLANDS.—Operations at the consuming plants have, in some cases, been limited by the inability of consumers to obtain adequate supplies. Deliveries are being strictly rationed. Contract renewals are usually made, but some makers have not been able to do this. Northants No. 3 is still officially at 83s. 6d., while Derbyshire and Lincolnshire No. 3 is 86s. Special grades of pig-iron continue to receive a heavy inquiry. Low-phosphorus iron is quoted at from £5 10s. to £6, with medium-phosphorus offered in small parcels only at around £5 5s. Refined iron is quoted at about £7 2s. 6d. per ton. Some producers of hematite have intimated that they will be able to offer additional supplies after the end of June. Before that time, however, prices will have been revised. Current quotations are £5 9s. 6d. for West Coast mixed numbers, £5 8s. 6d. for East Coast No. 3, and £5 8s. for Welsh mixed numbers, delivered to stations in the Midlands. If delivery into works in 10-ton lots is stipulated, an additional 1s. 6d. per ton is invoiced.

SCOTLAND.—No new contracts can be entertained, and makers have considerable difficulty in maintaining adequate deliveries. Prices are unchanged at 90s. 6d. for No. 1 foundry and 88s. for No. 3 foundry, f.o.t. furnaces. No. 3 Cleveland iron is quoted at 84s. f.o.t. Falkirk and 87s. f.o.t. Glasgow. Supplies to the steelworks continue to be below requirements and operations consequently are restricted to some extent. Mixed numbers of hematite are quoted at 98s., with basic, British and Indian, at 82s. 6d. These figures are subject to a rebate of 5s. per ton and are f.o.t. steelworks.

Coke

Makers have generally been able to keep deliveries of coke in accordance with their contractual commitments, but in some instances inconvenience has been caused to consumers by the shortage of supplies. For delivery to Birmingham and district, best Durham coke is quoted at 46s. 6d., minimum, with Welsh coke at from 47s. 6d. to 57s. 6d. per ton, according to quality.

Steel

Quiet conditions have ruled in the steel trade so far as new business is concerned, not from any decrease in the demand, but because the producers are so heavily booked for the next few months that they are reluctant to accept further orders, states the official report of the London Iron and Steel Exchange. At the same time, some consumers are disinclined to place contracts until the position with regard to prices during the latter half of the year has become more defined. All departments of the steel industry are making great efforts to maintain their deliveries, but although the works are operating at capacity so far as the supplies of raw materials available will permit, they are unable to meet fully the insistent demand. The scarcity of supplies in the semi-finished steel department is unrelieved, and a number of the re-rolling works have had to restrict their operations, and in some instances have had to close down temporarily. Little new business in finished steel is reported, owing to the congested state of the manufacturers' order books. The demand from all sections of the consuming industry shows no signs of relaxing and the makers are concentrating upon meeting consumers' more urgent needs.

Scrap

It is believed that the control scheme established by the British Iron and Steel Federation, in conjunction with the distributors, will be fully in operation in the near future. Price control has not been found easy to effect, but the final details are expected to be completed at an early date. Through the scheme it is hoped to secure better organisation of the trade and make co-operation between the steelmakers and the scrap merchants easier of attainment. It will also check exports of scrap from this country, the National Federation of Scrap Iron and Steel Merchants having agreed with the British Iron and Steel Federation not to export material needed by the home industry. This will be of definite advantage to the steel trade. Business during the past week has not involved any substantial tonnages. At a meeting to be held on April 22 the General Waste Materials Reclamation Trade Board will consider a motion, of which notice has been given by the workers' side, for increased wages in the scrap metal trade.

Metals

Copper.—Some recovery has been made in this market following a dull period, though prices have been on the weak side. Buying on industrial account declined to a low ebb, the reason being difficult to determine. Possibly consumers were a little nervous about entering the market on account of prevailing conditions. It has been further suggested that supplies have become more satisfactory.

Metal Exchange quotations were as follow :—

Cash.—Thursday, £64 to £64 2s. 6d.; Friday, £65 17s. 6d. to £66; Monday, £63 10s. to £63 15s.; Tuesday, £62 17s. 6d. to £63; Wednesday, £64 2s. 6d. to £64 5s.

Three Months.—Thursday, £63 3s. 9d. to £63 5s.; Friday, £65 2s. 6d. to £65 3s. 9d.; Monday, £62 10s. to £62 12s. 6d.; Tuesday, £61 15s. to £61 17s. 6d.; Wednesday, £62 12s 6d. to £62 15s.

Tin.—Over the week-end, consumers in the United States re-entered the market and helped considerably to bring about a revival in the market. Prices advanced and the tone of the market became firmer. The outlook at the present time is rather uncertain. Price fluctuations during the week have been within comparatively narrow limits.

Official quotations were as follow :—

Cash.—Thursday, £274 15s. to £275 5s.; Friday, £276 15s. to £277 5s.; Monday, £274 10s. to £274 15s.. Tuesday, £272 5s. to £272 15s.; Wednesday, £275 15s. to £276 5s.

Three Months.—Thursday, £272 to £272 10s.; Friday, £273 10s. to £273 15s.; Monday, £271 10s. to £271 15s.; Tuesday, £269 5s. to £269 15s.; Wednesday, £272 15s. to £273.

Spelter.—Consumption has been well maintained in this market and the outlook continues to be quite satisfactory. New business has not been substantial in the United States, but consumption is steady. The domestic quotation has been reduced to 7 cents per lb. East St. Louis. The reason for this is thought to be the desire to keep foreign metal out of the country.

Daily market prices :—

Ordinary.—Thursday, £28 2s. 6d.; Friday, £28 6s. 3d.; Monday, £26 15s.; Tuesday, £26 6s. 3d.; Wednesday, £26 2s. 6d.

Lead.—Business has not been particularly good in this market, but the undertone continues to be quite firm. Supplies certainly are more plentiful, following increases in production. Quiet conditions have prevailed in the United States and the price has fallen to 6 cents per lb.

Soft Foreign (Prompt).—Thursday, £27 6s. 3d.; Friday, £27 10s.; Monday, £26 10s.; Tuesday, £25 7s. 6d.; Wednesday, £25 13s. 9d.

Company Meeting

The annual meeting of the International Nickel Company of Canada, Limited, was held recently in Toronto. MR. ROBERT C. STANLEY (chairman and president), in his address to the shareholders, said that since 1932 metal industries the world over had been gradually recovering from a very serious trade depression. The nickel industry recovered somewhat in advance of other basic industries, the reasons being twofold. In the first place, research and sales activities were continued and even augmented during the years of depression, with the result that nickel had been introduced into diversified fields and had taken its place as an essential industrial metal. Secondly, the installation of modern facilities throughout all of the company's properties had widened the range and improved the quality of products. However, it should be noted that metallurgy and research were simply the means for revealing and employing the latent worth possessed by nickel, which in many instances did what no other metal could do. It was on this premise that further progress of the world's nickel industry largely depended. Exploratory work which had been conducted during the past two years in Finland had shown satisfactory results. Work on this nickel-copper property would be continued. On the commercial side 1936 was outstanding in that the company sold more nickel, copper and platinum metals than in any previous year. Sales of nickel totalled 168,927,980 lbs., compared with 129,850,207 lbs. in 1935, the previous record year of consumption. It was of interest to note that 54 per cent. of the company's sales of nickel were in the United States and Canada and the balance distributed over the rest of the world. Consumption in the United States and Canada increased 35 per cent. over the preceding year and consumption elsewhere increased 25 per cent. These figures were significant in that they refuted the suggestion, sometimes made, that the prosperity and development of the company were based upon military expenditures. The new research laboratory in Birmingham was completed and opened on October 21 last year. It was one of the largest laboratories in Europe erected by a single company and devoted solely to metallurgical research.

Company Reports

Drakes, Limited.—Profit for 1936 of £5,119, which, together with £3,574 brought in, is carried forward.

John Thompson Engineering Company, Limited.—Final dividend on the ordinary shares of 12½ per cent., making 17½ per cent. actual, for the initial trading period to December 31.

Stewarts and Lloyds, Limited.—Dividend on the deferred stock at the rate of 7½ per cent. for the year 1936. A payment will be made on the liaison deferred shares at the same rate relatively as on the deferred stock.

Barrow Hematite Steel Company, Limited.—Profit for 1936, £75,763; interest on prior lien short-term notes, £17,500; interest on 6 per cent. first debenture stock, £25,942; debit balance brought in, £27,758; credit balance carried forward, £4,562. Meeting, April 16.

Steel Company of Canada, Limited.—Net profit for 1936, $2,886,683; brought in, $13,054,244; in addition to quarterly dividends aggregating $1.75 a share paid on the ordinary shares an additional dividend of $2 a share was declared towards equalising the dividends paid on the ordinary and preference shares of the company; to benefit plan reserve, $100,000; to pension plan reserve, $200,000; carried forward, $13,461,186.

MR. F. C. WESSON, ironfounder, and MR. F. C. WILEY, nut and bolt manufacturer, have been re-elected as members of the Darlaston Urban Council.

For **"easy stripping"** use

YORKSHIRE SAND

Yorkshire Sand is of a synthetic nature, its production being under careful laboratory control. Perfect standardization is obtained with the various grades, suitable for light and the heaviest steel castings.

It is because of the refractoriness of the sand and of the toughness of the mould surface that castings made with Yorkshire Sand are distinguishable by their excellent finish.

Please address all enquiries to the nearest Sales Office :

GENERAL REFRACTORIES LTD.,

Genefax House, Sheffield

Telephone : *Sheffield 31113 (6 lines).*

Telegrams : *"Genefax, Sheffield."*

LONDON OFFICE: Russell House, Adelphi, W.C.2.
Telephone: Temple Bar 7361. Telegrams: "Genefax, Rand-London." Mr. A. C. Turner.

SCOTTISH OFFICE: 48, West Regent Street, Glasgow. Telephone: 3009. Telegrams: "Genefax, Glasgow." (Mr. C. A. G. Thomson.)

MANCHESTER OFFICE: 9, Albert Square, Manchester, 2. Telephone: Blackfriars 6130. Telegrams: "Genefax, Manchester." (Mr. S. G. Throssell.)

SWANSEA OFFICE: Metropole Chambers, Wind Street, Swansea. Telephone: 3680. Telegrams: "Genefax, Swansea." (Mr. D. Hood-Williams.)

CARDIFF OFFICE: 17, Windsor Place, Cardiff. Telephone: 5796. Telegrams: "Genefax, Cardiff." (Mr. F. E. Rutter.)

MIDDLESBROUGH OFFICE: Halifax Buildings, Exchange Place.
Telephone: Middlesbrough 3313. Telegrams: "Genefax, Middlesbrough." (Mr. C. Souness.)

★

Read what an IMPORTANT STEELFOUNDER says :—

"During the 40 years I have been connected with Steel Foundry work, considerable changes have taken place. Away back, we had Steel Moulders' Composition, Old Crucible Pots, etc., and each works claimed to have its own 'secret' moulding composition. High Silica Sand has eliminated practically all these from many foundries and to-day we have your 'Yorkshire Sand' which acts almost like a chill, and leaves the skin of the casting blue-black and as clean as cast iron.

The hot steel lies quietly against the wall of sand, and often when the casting has been lifted out of the mould, the latter looks as if it could be used over again, just like a permanent mould."

RAW MATERIALS—PRICE LIST

(Wednesday, April 14, 1937)

COPPER

	£	s.	d.
Standard cash	64	2	6
Three months	62	12	6
Electrolytic	68	10	0
Tough	68	15	0
Best selected	68	5	0
Sheets	100	0	0
India	79	0	0
Wire bars	69	10	0
Ingot bars	69	10	0
H.C. wire rods	73	0	0
Off. av. cash, Mar.	72	8	11½
Do., 3 mths., Mar.	71	1	5½
Do., Sttlmnt., Mar.	72	7	11½
Do., Electro, Mar.	77	18	6½
Do., B.S., Mar.	77	5	3½
Do., wire bars, Mar.	77	18	6½
Solid drawn tubes			15d.
Brazed tubes			15d.
Wire			11d.

BRASS

Solid drawn tubes	13½d.
Brazed tubes	15½d.
Rods, drawn	11½d.
Rods, extd. or rlld.	8½d.
Sheets to 10 w.g.	11½d.
Wire	10½d.
Rolled metal	10½d.
Yellow metal rods	8½d.

TIN

	£	s.	d.
Standard cash	275	15	0
Three months	272	15	0
English	276	0	0
Bars	278	0	0
Straits	276	10	0
Australian		—	
Eastern	275	0	0
Banca	277	5	0
Off. av. cash, Mar.	283	5	7½
Do., 3 mths., Mar.	278	19	6½
Do., Sttlmt., Mar.	283	4	0½

SPELTER

	£	s.	d.
Ordinary	26	2	6
Remelted	26	10	0
Hard	25	0	0
Electro 99.9	28	15	0
English	27	12	6
India	24	0	0
Zinc dust	28	10	0
Zinc ashes	10	10	0
Off. aver., Mar.	33	5	11 1/14
Aver. spot, Mar.	33	3	9

LEAD

	£	s.	d.
Soft foreign, ppt.	25	13	9
Empire (nom.)	26	2	6
English	27	10	0
Off. aver., Mar.	33	0	0½
Aver. spot, Mar.	33	0	6½

ALUMINIUM

Ingots	£100 to £105
Wire	1/3 to 1/4 lb.
Sheet and foil	1/2 to 1/4 lb.

ZINC SHEETS, &c.

Zinc sheets, English	38	10	0	to 39	0	0
Do., V.M. ex-whse.	38	10	0	to 39	0	0
Rods				40	0	0

ANTIMONY

English	88	0	0	to 89	0	0
Chinese, ex-whse.				76	10	0
Crude, c.i.f.				42	10	0

QUICKSILVER

Quicksilver	14	7	3

FERRO-ALLOYS AND STEEL-MAKING METALS

Ferro-silicon—						
25%	(nom.)	10	15	0		
45/50%	10	15	0	to 12	0	0
75%	15	15	0	to 17	0	0
Ferro-vanadium—						
35/50%				12/8 lb. Va		
Ferro-molybdenum—						
70/75% carbon-free				4/9 lb. Mo.		
Ferro-titanium—						
20/25% carbon-free				9d. lb.		
Ferro-phosphorus, 20/25%				£21 to £22		
Ferro-tungsten—						
80/85%				5/– lb. (nom.)		
Tungsten metal powder—						
98/99%				5/3 lb. (nom.)		
Ferro-chrome—						
2/4% car.				31	17	6
4/6% car.				21	10	0
6/8% car.				21	0	0
8/10% car.				21	0	0
Ferro-chrome—						
Max. 2% car.				32	10	0
Max. 1% car.				35	15	0
Max. 0.5% car.				36	10	0
70% carbon-free				9½d. lb.		
Nickel—99.5/100%				£180 to £185		
"F" nickel shot				£165	0	0
Ferro-cobalt, 98/99%				7/3 lb.		
Metallic chromium—						
96/98%				2/5 lb.		
Ferro-manganese—						
76/80% loose	£13	15	0	to 14	5	0
76/80% packed	£14	15	0	to 15	5	0
76/80% export				£13	0	0
Metallic manganese—						
94/96% carbon-free				1/3 lb.		

Per ton unless otherwise stated, basis 2-ton lots.

HIGH-SPEED TOOL STEEL

Finished bars, 14% tungsten	2s. 2d.
Finished bars, 18% tungsten	3s. 0d.

Per lb. net, d/d buyers' works.

Extras—	
Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under ½ in. to ¼ in.	3d. lb.
Do., under ¼ in. to 1/16 in.	1/– lb.
Flats, ½ in. × ¼ in. to under 1 in. × ⅛ in.	3d. lb.
Do., under ½ in. × ¼ in.	1/– lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

SCRAP

	£	s.	d.	£	s.	d.
South Wales—						
Heavy steel	3	8	0	to 3	10	0
Mixed iron and steel	3	5	0	to 3	7	6
Heavy cast iron	3	8	0	to 3	10	0
Good machinery	4	0	0	to 4	5	0
Cleveland—						
Heavy steel			3	7	0	
Steel turnings			2	12	6	
Heavy cast iron	3	17	6	to 4	2	6
Heavy machinery	4	2	6	to 4	5	0
Midlands—						
Short heavy steel	3	12	6	to 3	15	0
Light cast-iron scrap			3	5	0	
Heavy wrought iron	3	17	6	to 4	2	6
Steel turnings	2	2	6	to 2	5	0
Scotland—						
Heavy steel	3	4	6	to 3	7	0
Ordinary cast iron			4	2	6	
Cast-iron borings	2	0	0	to 2	2	6
Wrot-iron piling			4	2	6	
Heavy machinery	4	7	6	to 4	10	0

London—Merchants' buying prices, delivered yard.

	£	s.	d.	£	s.	d.
Copper (clean)			52	0	0	
Brass			30	0	0	
Lead (less usual draft)			20	10	0	
Tea lead			16	0	0	
Zinc			14	0	0	
New aluminium cuttings			74	0	0	
Braziery copper			46	0	0	
Gunmetal			52	0	0	
Hollow pewter			180	0	0	
Shaped black pewter			147	0	0	

PIG-IRON

N.E. Coast (d/d Tees-side area)—	
Foundry No. 1	83/6
,, No. 3	81/–
,, No. 4	80/–
Forge No. 4	80/–
Hematite No. 1	98/–*
Hematite M/Nos.	97/6*
N.W. Coast—	
Hem. M/Nos. d/d Glas.	98/–*
,, d/d Birm.	109/6*
Malleable iron d/d Birm.	135/–
Midlands (d/d Birmingham dist.)—	
Staffs No. 4 forge	83/–
,, No. 3 fdry.	86/–
Northants forge	80/6
,, fdry. No. 3	83/6
,, fdry. No. 1	86/6
Derbyshire forge	83/–
,, fdry. No. 3	86/–
,, fdry. No. 1	89/–
Scotland—	
Foundry, No. 1, f.o.t.	90/6
,, No. 3, f.o.t.	88/–
Cleveland No. 3, Glasgow	87/–
,, ,, Falkirk	84/–
Scottish hem. M/Nos. d/d	98/–*
Sheffield (d/d district)—	
Derby forge	80/6
,, fdry. No. 3	83/6
Lincs forge	80/6
,, fdry. No. 3	83/6
W.C. hematite	103/6*
Lancashire (d/d eq. Man.)—	
Derby fdry. No. 3	89/–
Staffs fdry. No. 3	89/–
Northants fdry. No. 3	87/6
Cleveland fdry. No. 3	89/–
Glengarnock, No. 3	106/–
Clyde, No. 3	106/–
Monkland, No. 3	106/–
Summerlee, No. 3	106/–
Eglinton, No. 3	106/–
Gartsherrie, No. 3	106/–
Shotts, No. 3	106/–

* Subject to a rebate of 5s. per ton under certain conditions.

FINISHED IRON AND STEEL

Usual district deliveries for iron; delivered consumer's station for steel.

Iron—	£	s.	d.	£	s.	d.
Bars (cr.)				11	17	6
Nut and bolt iron	10	5	0	to 10	15	0
Hoops				12	15	0
Marked bars (Staffs) f.o.t.				14	7	6
Gas strip				12	15	0
Bolts and nuts, ¼ in. × 4 in.				17	10	0 and up.
Steel—						
Plates, ship, etc.	9	10	6	to 9	13	0
Boiler plts	10	0	6	to 10	3	0
Chequer plts.				11	3	0
Angles				9	3	0
Tees				10	3	0
Joists				9	3	0
Rounds and squares, 3 in. to 5½ in.				10	3	0
Rounds under 3 in. to ½ in. (Untested)				9	10	0
Flats—8 in. wide and over				9	8	0
,, under 8 in. and over 5 in.				9	13	0
Rails, heavy	8	5	0	to 8	10	0
Fishplates				12	10	0
Hoops (Staffs)				10	5	0
Black sheets, 24g. (4-t. lots)				14	0	0
Galv. cor. shts. (,,)				17	0	0
Galv. flat shts. (,,)				17	10	0
Galv. fencing wire, 8g. plain				16	0	0
Billets, soft				6	5	0
Sheet bars			6	2	6 and up.	
Tin bars			6	2	6 and up.	

PHOSPHOR BRONZE

	Per lb. basis
Strip	14d.
Sheet to 10 w.g.	15d.
Wire	15½d.
Rods	16d.
Tubes	21d.
Castings	16d.

Delivery 3 cwt. free.
10% phos. cop. £33 above B.S.
15% phos. cop £38 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. Clifford & Son, Limited.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	10d. to 1/4
Rolled—	
To 9 in. wide	1/4 to 1/10
To 12 in. wide	1/4½ to 1/10½
To 15 in. wide	1/4½ to 1/10½
To 18 in. wide	1/5 to 1/11
To 21 in. wide	1/5½ to 1/11½
To 25 in. wide	1/6 to 2/–
Ingots for spoons and forks	10d. to 1/6½
Ingots rolled to spoon size	1/1 to 1/9½
Wire round—	
to 10g.	1/7½ to 2/2½

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/6½ upwards.

AMERICAN IRON AND STEEL

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	25.76
No. 2 foundry, Valley	24.00
No. 2 foundry, Birm.	20.38
Basic, Valley	23.50
Malleable, Valley	24.00
Grey forge, Valley	20.50
Ferro-mang. 80%, seaboard	95.00
O.-h. rails, h'y, at mill	42.50
Billets	37.00
Sheet bars	37.00
Wire rods	47.00
	Cents.
Iron bars, Chicago	2.40
Steel bars	2.45
Tank plates	2.25
Beams, etc.	2.15
Skelp, grooved steel	2.10
Steel hoops	2.10
Sheets, black, No. 24	2.40
Sheets, galv., No. 24	3.80
Wire nails	2.75
Plain wire	2.90
Barbed wire, galv.	3.40
Tinplates, 100-lb box	$4.85

COKE (at ovens)

Welsh foundry	32/6 to 33/–
,, furnace	27/– to 28/–
Durham foundry	31/–
,, furnace	30/–
Scotland foundry	—
,, furnace	—

TINPLATES

f.o.b. Bristol Channel ports.

I.C. cokes	20×14	per box	24/– to 25/–
,,	28×20	,,	48/– to 50/–
,,	20×10	,,	31/– to 32/–
,,	18¾×14	,,	24/6 to 25/6
C.W.	20×14	,,	21/– to 22/–
,,	28×20	,,	42/– to 43/–
,,	20×10	,,	26/– to 27/–
,,	18¾×14	,,	21/6 to 22/6

SWEDISH CHARCOAL IRON & STEEL

Pig-iron	£12	0	0	to £13	0	0
Bars-hammered, basis	£19	0	0	to £20	0	0
Bars and nail-rods, rolled, basis	£19	0	0	to £20	0	0
Blooms	£14	0	0	to £14	10	0
Keg steel	£26	0	0	to £29	0	0
Faggot steel	£19	0	0	to £25	0	0
Bars and rods dead soft, st'.	£16	0	0	to £18	0	0

All per English ton, f.o.b. Gothenburg.
[Subject to an exchange basis of Kr. 19.39 to £1.]

DAILY FLUCTUATIONS

Standard Copper (cash)

		£	s.	d.		
Apr.	8 ..	64	0	0	inc.	5/-
„	9 ..	65	17	6	„	37/6
„	12 ..	63	10	0	dec.	47/6
„	13 ..	62	17	6	„	12/6
„	14 ..	64	2	6	inc.	25/-

Electrolytic Copper

		£	s.	d		
Apr.	8 ..	69	0	0	inc.	40/-
„	9 ..	70	0	0	„	20/-
„	12 ..	68	0	0	dec.	40/-
„	13 ..	68	10	0	inc.	10/-
„	14 ..	68	10	0	No	change

Standard Tin (cash)

		£	s.	d.		
Apr.	8 ..	274	15	0	inc.	55/-
„	9 ..	276	15	0	„	40/-
„	12 ..	274	10	0	dec.	45/-
„	13 ..	272	5	0	„	45/-
„	14 ..	275	15	0	inc.	70/-

Tin (English ingots)

		£	s.	d.		
Apr.	8 ..	275	0	0	inc.	50/-
„	9 ..	277	0	0	„	40/-
„	12 ..	274	15	0	dec.	45/-
„	13 ..	272	10	0	„	45/-
„	14 ..	276	0	0	inc.	70/-

Spelter (ordinary)

		£	s.	d.		
Apr.	8 ..	28	2	6	inc.	42/6
„	9 ..	28	6	3	„	3/9
„	12 ..	26	15	0	dec.	31/3
„	13 ..	26	6	3	„	8/9
„	14 ..	26	2	6	„	3/9

Spelter (Electro, 99.9 per cent.)

		£	s.	d.		
Apr.	8 ..	30	15	0	inc.	42/6
„	9 ..	30	18	9	„	3/9
„	12 ..	29	7	6	dec.	31/3
„	13 ..	28	18	9	„	8/9
„	14 ..	28	15	0	„	3/9

Lead (soft foreign, prompt)

		£	s.	d.		
Apr.	8 ..	27	6	3	inc.	32/6
„	9 ..	27	10	0	„	3/9
„	12 ..	26	10	0	dec.	20/-
„	13 ..	25	7	6	„	22/6
„	14 ..	25	13	9	inc.	6/3

Lead (English)

		£	s.	d.		
Apr.	8 ..	29	5	0	inc.	30/-
„	9 ..	29	10	0	„	5/-
„	12 ..	28	10	0	dec.	20/-
„	13 ..	27	10	0	„	20/-
„	14 ..	27	10	0	No	change

AVERAGE MONTHLY PRICES OF UNMARKED BARS (SOUTH STAFFS)

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1902	7 0 0	6 10 0	6 15 0	6 15 0	6 15 0	6 10 0	6 10 0	6 15 0	6 15 0	6 15 0	6 10 0	6 10 0	6 13 4
1903	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 7 0	6 5 0	6 9 4½
1904	6 5 0	6 5 0	6 5 0	6 5 0	6 10 0	6 5 0	6 0 0	6 0 0	6 0 0	6 0 0	6 0 0	6 0 0	6 2 11½
1905	6 5 0	6 5 0	6 0 0	5 17 6	5 15 0	5 15 0	5 15 0	5 15 0	6 0 0	6 5 0	6 15 0	6 15 0	6 1 10
1906	7 0 0	7 5 0	7 5 0	7 5 0	6 17 6	6 15 0	6 12 6	6 10 0	6 10 0	6 12 6	6 16 3	7 3 9	6 17 8
1907	7 3 9	7 5 0	7 5 0	7 5 0	7 5 0	7 7 6	7 5 0	7 7 6	7 7 6	7 7 6	7 7 6	7 5 0	7 5 11
1908	7 2 6	7 0 0	7 0 0	7 0 0	6 15 0	6 7 6	6 5 0	6 2 6	6 2 6	6 2 6	6 2 6	6 0 0	6 10 0½
1909	6 0 0	6 0 0	6 0 0	5 17 6	6 0 0	6 0 0	6 0 0	6 0 0	6 0 0	6 2 6	6 2 6	5 17 6	5 19 9
1910	6 2 6	6 3 4½	6 7 6	6 7 6	6 7 6	6 7 6	6 6 6	6 5 0	6 5 0	6 5 0	6 5 0	6 5 0	6 5 7
1911	6 5 0	6 5 0	6 5 0	6 5 0	6 5 0	6 5 0	6 5 0	6 5 0	6 5 0	6 10 0	6 12 6	6 10 6	6 7 0
1912	6 18 9	7 1 10	7 2 6	7 8 9	7 18 0	8 0 7	8 2 6	8 3 6	8 5 0	8 6 3	8 7 6	8 8 9	7 17 0
1913	8 11 6	8 10 7½	8 10 0	8 8 1½	8 2 0	8 0 0	7 17 6	7 11 6	7 8 9	7 5 6	6 18 1½	6 17 6	7 16 9
1914	6 17 6	6 15 7½	6 12 6	6 10 0	6 10 0	6 10 0	6 10 0	7 11 10½	8 0 0	7 12 6	7 5 7½	7 6 3	7 1 0
1915	7 11 6	8 5 11	8 8 9	9 6 0	10 3 2	10 19 2	11 12 6	11 13 1½	11 13 9	11 14 3	12 1 10½	13 0 9	10 6 0½
1916	13 7 6	13 10 8	13 12 9½	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 8 9
1917	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0½
1918	13 15 0	13 17 3	13 17 6	13 17 6	13 17 6	13 17 6	13 17 6	14 15 0	14 15 0	14 15 0	14 15 0	14 15 0	14 4 5
1919	15 10 0	16 5 0	17 15 0	17 15 0	20 15 0	21 0 0	21 0 0	22 0 0	22 0 0	22 0 0	22 7 6	22 12 6	20 1 8
1920	24 7 6	24 10 0	25 10 0	27 10 0	29 5 0	31 0 0	31 10 0	31 10 0	31 10 0	31 10 0	31 10 0	29 7 6	29 1 8
1921	26 17 3	25 0 0	23 0 0	21 0 0	19 0 0	18 5 0	16 0 0	16 0 0	15 14 0	14 0 0	13 6 8	13 0 0	19 4 5½
1922	13 0 0	12 3 9	11 14 0	11 11 10½	11 5 0	11 3 6	11 2 6	11 5 0	10 17 2½	10 16 3	10 13 0	10 12 6	11 7 0½
1923	10 16 10½	11 3 1½	12 2 6	12 8 9	12 11 6	12 1 3	11 15 11½	11 15 0	11 15 0	11 15 0	12 13 6	12 8 3	11 18 10½
1924	12 9 6	12 10 0	12 10 0	12 15 7½	12 17 6	12 17 6	12 17 6	12 17 6	12 17 6	12 14 0	12 12 6	12 12 6	12 14 3½
1925	12 12 6	12 12 6	12 12 6	12 12 6	12 12 6	12 7 6	12 7 6	12 7 6	12 4 6	11 18 6	11 13 9	11 13 0	12 6 2
1926	11 7 9½	11 5 0	11 5 0	11 5 0	11 3 9	11 3 9	11 5 0	12 0 0	13 0 0	*	15 7 6	12 19 0	12 0 2
1927	12 6 3	12 2 6	11 14 0	11 0 0	10 18 9	10 13 6	10 12 6	10 5 0	9 16 0	9 15 0	9 13 9	9 12 9	10 14 2
1928	9 12 6	9 12 6	9 11 0	9 10 0	9 8 4	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 3 6	9 1 3	9 7 0
1929	9 0 0	9 2 6	9 5 7½	9 9 4½	9 10 0	9 17 6	10 2 6	10 2 6	10 2 6	10 0 6	10 3 9	10 5 7	9 15 2½
1930	10 7 6	10 7 6	10 7 6	10 6 10½	10 6 3	10 5 0	10 2 6	10 2 6	10 2 6	10 2 6	10 2 6	10 2 6	10 4 7½
1931	10 2 6	10 0 0	10 0 0	10 0 0	9 18 1½	9 17 6	9 17 6	9 17 6	9 17 6	9 17 6	9 17 6	9 16 10½	9 18 0½
1932	9 15 0	9 15 0	9 15 0	9 15 0	9 13 9	9 11 3	9 10 0	9 10 0	9 10 0	9 6 3	9 5 0	9 5 0	9 10 11½
1933	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0
1934	9 5 0	9 8 1½	9 12 6	9 12 6	9 12 6	9 12 6	9 12 6	9 12 6	9 12 6	9 12 6	9 12 6	9 12 6	9 11 6
1935	9 12 6	9 12 6	9 12 6	9 12 6	9 12 6	9 12 6	9 12 6	9 12 6	9 12 6	9 12 6	9 12 6	9 12 6	9 12 6
1936	9 12 6	9 15 0	10 2 6	10 2 6	10 2 6	10 2 6	10 6 3	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 4 5½
1937	10 10 0	10 10 0	11 17 6	—	—	—	—	—	—	—	—	—	—

* No quotation available owing to strike.

WILLIAM JACKS & COMPANY,

WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

CLARENCE CHAMBERS, 39, CORPORATION STREET, BIRMINGHAM.

13, RUMFORD STREET, LIVERPOOL.

PIG IRON

REGISTERED TRADE MARK

LUMPEX

FOR EVERY TYPE OF CASTING

NON-FERROUS METALS

REFRACTORIES — COKE — SAND

FERRO-SILICON—FERRO-CHROME

WILLIAM JACKS & COMPANY,

CENTRAL CHAMBERS, 93, HOPE ST., GLASGOW, C.2.

ZETLAND ROAD, MIDDLESBROUGH.

Notice

Small Advertisements in this section of the Journal are accepted at the prepaid rate of 6d. per line, first line in capitals counting two, average 6 words per line. Minimum charge for one insertion 3/-

(A remittance should accompany instructions.)

SITUATIONS VACANT AND WANTED

FOUNDRY Foreman desires a change. A qualified practical man, keen and energetic, used to green and dry sand, plate and machine moulding; used to different classes of work; first-class knowledge of cupola work and metal mixing. Would prefer Manchester or Salford or Radcliffe district.—Box 332, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

FOUNDRY Foreman seeks re-engagement. Experienced in production of high-class general engineering castings made in loam, dry and green sand; moulding machines and repetition work. Good organising abilities and metallurgical knowledge.—Box 334, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

TO FOUNDRY OWNERS.—Are you guided by job costs? Experienced Chief Cost Clerk desires change. Write for further particulars to: Box 330, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

A VACANCY occurs for an Engineer or Metallurgist to act as an Assistant in a London editorial office. Applicants should possess as many of the following attributes as possible:—Practical experience in foundry practice or sheet metal fabrication; ability to write well; knowledge of modern languages and active participation in the work of technical societies. Applicants should give the usual educational and personal details and state the salary they require, to: Box 874, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

RESEARCH Engineer required in the Midlands with the following qualifications:—(1) Scientific training in physics, mechanics, mathematics and some knowledge of metallurgy. (2) Practical engineering experience. (3) Some experience of moulding machines and sand preparation. (4) Ability to conduct experiments and solve problems on own initiative. Apply, stating wages required, to: Box 338, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

WANTED.—Experienced Moulder for small aluminium foundry in London; to take charge as Working Foreman. Write in confidence.—Box 336, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

WANTED.—Several first-class Moulders, immediately.—Apply MANAGER, MESSRS. CHAS. WICKSTEED & CO., LTD., Kettering.

YOUNG Engineer for estimating production times in non-ferrous foundries and machine shops. The production time estimates are required for working in connection with a "standard cost system." Write in confidence, stating age, experience, and salary required, to: THE PHOSPHOR BRONZE CO., LTD., Chester Street, Aston, Birmingham, 6. Envelopes to be marked "Estimating Engineer."

WORKS MANAGER required for an old-established and important Roll Foundry. Must be thoroughly experienced in the manufacture of chilled, grain and alloy rolls, and a good works and foundry organiser. Substantial salary to the right man. Apply, stating full details of experience, which would be treated in strict confidence, to: Box 326, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

PROPERTY

WANTED.—Small factory, fully equipped, suitable for complete manufacture of water taps.—Reply to: Box 340, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

PUBLICATION

RYLAND'S DIRECTORY of the Coal, Iron, Steel, Tinplate, Metal, Engineering, Hardware and Allied Trades. 1936 edition completely out of print. Next edition 1938. Price 42s. cloth bound. Order your copy now.—INDUSTRIAL NEWSPAPERS, LIMITED, 49, Wellington Street, Strand, London, W.C.2.

MACHINERY

SAND MIXERS AND AERATORS.—The "Breakir" Centrifugal Machine is *THE* machine. Outputs 10 cwts. to 8 tons per hr.—W. BREALEY & CO., LTD., Station Works, Ecclesfield, Sheffield.

NEW Dwarf Cupola, to melt 10 to 15 cwts. per hr. New Worm-geared Ladles, 5 tons, 25 cwts., 15 cwts. and 10 cwts. capacity. Ungeared Ladles, 15 cwts. and 10 cwts. capacity. Improved Cupola Spark Arresters.—T. DAVIES & SON, West Gorton, Manchester.

'Phone **98** Staines.

VERTICAL Boiler, 8 ft. 8 in. by 4 ft., 80 lbs. w.p.
8-in. Roots Blower, as new, 5 lbs. pressure.
Horizontal Compressor, steam driven, 8 in. and 8½ in. by 9 in.
Air Receiver, 11 ft. 6 in. by 2 ft. 6 in
Air Receiver, 20 ft. by 3 ft.
HARRY H. GARDAM & CO., LTD., STAINES.

ELECTRIC CUPOLA BLOWERS (large stock), including two 50-h.p. 3/50/400 volts, 2,900 r.p.m.; Keith Blackman; 12-in. outlet.
30-h.p. ditto; 12-in. outlet.
5-h.p. ditto; 6-in. outlet.
20-h.p. 460 volts d.c., 2,400/1,900 r.p.m.; 10-in. outlet.
EXHAUST FANS (large stock), electrical and belt driven.
ELECTRIC RUNWAY LIFTING BLOCKS:
One 4½-ton 460 volts d.c., Vaughan.
Two 2-ton ditto, Morris.
One ½-ton 220 volts d.c., Morris (as new).
One ½-ton 3/50/440 volts, Aabacas.
Two Reavell Rotary Compressors, 12 lbs. sq. in. pressure; 750 cub. ft. direct-coupled on bedplate to 60 h.p. S.R., 3/50/400 volts motor.
½-cwt. Pilkington Self-contained Pneumatic Hammer.
Geared Foundry Ladles, 9, 4, 3½, 2½ and 1 ton, etc.
AIR COMPRESSORS: 30 in stock in sizes 500 to 20 cub. ft.
ELECTRIC MOTORS: Large stock to suit almost all electric systems.
S. C. BILSBY, A.M.I.C.E., A.M.I.E.E.
CROSSWELLS ROAD (Adjoining Railway Crossing), LANGLEY, Nr. Birmingham.
'Phone: Broadwell 1359.

THOS. W. WARD LTD.
VERT. COCHRAN BOILER; 11′ 3″ x 5′; 100 lbs. w.p.
WIRE ROPES; 13/32″ dia., 360′ long.
"International" and "Dey" TIME RECORDERS.
75′ STEEL SOCKETED PIPING; 24″ dia., in 25′ lengths.
Write for "Albion" Catalogue.
'Grams: "Forward." 'Phone: 23001 (10 lines).
ALBION WORKS, SHEFFIELD.

MACHINERY—*Continued*

FOR SALE.—Two 35-ton steel Ladles, by Stephenson of Preston, in first-class condition; fitted with stoppers and complete with turning gear. Can be seen by appointment.—Apply COLTNESS IRON CO., LTD., 36, Robertson Street, Glasgow, C.2.

MISCELLANEOUS

TAPS.—Company require large quantities of water taps to be manufactured to own specifications; reliable and prompt delivery essential.—Reply to: HOPE, AGAR & Co., Pinners Hall, Austin Friars, London, E.C.

GENUINE Southport Wind Blown Sand, which makes best oil-sand cores. Prompt deliveries by road into works.
JOHN LIVESEY,
SAND MERCHANT,
SOUTHPORT.

FLUIDITY TESTS.—Patterns for these tests as described in F.T.J. of September 24 by Carl F. Joseph. Made in aluminium from our master pattern. 35s. per set. We shall also be glad to have your inquiries for patterns in hard or soft woods for all kinds of engineering, large and small.—FURMSTON & LAWLOR, Pattern Makers, Letchworth.

SAND.—Hill and Sea Sand delivered by road or rail at your works. Write for prices.—THOMAS BALL & SONS, C.L.C. Goods Station, Southport.

'Phone: 287 SLOUGH

SEVERAL Good Foundry Grinders, Price, £5 to £20.

12′ square Sand Blast Room Plant complete and in good condition. Price, £180.

Four Morgan Oil-fired Tilting Furnaces reconditioned — 450-lbs. capacity. Also 250-lbs. and 600-lbs. capacity in stock. CHEAP.

Large stock of Moulding Machines, Compressors and A.C. Motors.

PLEASE SEND US YOUR ENQUIRIES.

ALEX. HAMMOND, *Foundry Machinery Merchant.*
14, AUSTRALIA ROAD, SLOUGH
BUY FROM ME AND SAVE MONEY!

WHEN THINKING OF
SANDBLAST
THINK OF
RICHARDSON'S
Established 1887.
We Supply Re-Conditioned & New
SAND BLAST PLANTS
AND
AIR COMPRESSORS.
Tilghman's, Room, Barrel, Chamber, Rotary Table, Dust Arrester, and Continuous Feed Barrel Plants.
Phone: MIDLAND 2281.
Grams: "SANDBLAST, B'HAM."
R. J. RICHARDSON & SONS, Ltd.,
Commercial Street, Birmingham.